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Introduction

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INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **1987**

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1990**

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **1993**

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **1997**

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **2003**

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **2008**

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **2025**

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **2031**

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **2038**

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **2041**

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **2046**

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **2050**

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **2056**

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **2065**

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. **2073**

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **2078**

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **2080**

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **2086**

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **2090**

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Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 2097

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Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 2103

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Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 2109

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Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 2123

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Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 2130

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Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 2140

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Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 2142

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Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 2145

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Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 2148

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2154**

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33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2165**

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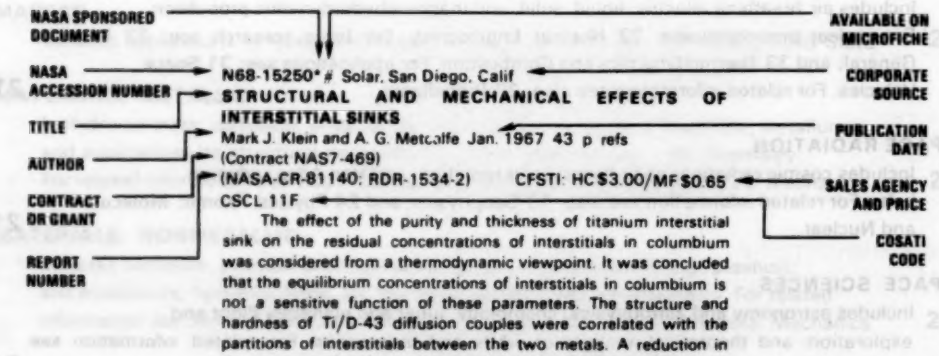
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N68-15250* # Solar, San Diego, Calif
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 6 NUMBER 13 / JULY 8, 1968

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-23194# ARO, Inc., Arnold Air Force Station, Tenn.
EFFECTS OF RADIATED AERODYNAMIC NOISE ON MODEL BOUNDARY-LAYER TRANSITION IN SUPERSONIC AND HYPERSONIC WIND TUNNELS Final Report, 3 Jun. 1966–23 Jan. 1967
S. R. Pate and C. J. Schueler Arnold Eng. Develop. Center Mar. 1968 94 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-236; AD-666644)

Boundary-layer transition and aerodynamic noise measurements were made on sharp leading-edge two-dimensional models in supersonic wind tunnels (1 ft to 16 ft). These data showed, conclusively, a significant and continuous increase in transition Reynolds number and a significant decrease in radiated aerodynamic noise (generated by the tunnel wall turbulent boundary layer) with increasing tunnel size. Results obtained in the AEDC-VKF Tunnel A from a shroud configuration placed concentrically around a hollow cylinder transition model and a flat plate microphone model further demonstrated the strong adverse effects that radiated aerodynamic noise will have on transition. A correlation of transition Reynolds numbers based on transition data from nine wind tunnels ($3 < \text{or} = M < \text{or} = 8$) was developed. The correlation was dependent only on the tunnel wall, turbulent boundary layer, aerodynamic noise parameters (displacement thickness and skin friction), and the tunnel test section circumference. Author (TAB)

N68-23212# Aeronautical Research Council (Gt. Brit.).
HALF-BODY AND WING COMBINATIONS IN SUPERSONIC FLOW: A REVIEW OF SOME PRINCIPLES AND POSSIBILITIES
E. L. Goldsmith and P. H. Cook London HMOS 1968 42 p refs Supersedes RAE-TR-65040; ARC-27303
(ARC-R&M-3528; RAE-TR-65040; ARC-27303) CFSTI: HC $3.00/MF $0.65

A brief review is made of simple theory for predicting the maximum lift-to-drag ratio for combinations of half-body and wing in supersonic flow, allowing for the so-called favourable interference. A comparison is given of experimental and calculated results obtained using this theory. The calculations are extended to show trends (comparing asymmetric and equivalent symmetric configurations) with design Mach number, body and wing shape, etc. The role of the engine nacelle in this context is also examined. Some sketches are included to show how interference principles might possibly be used in the design of supersonic aircraft. Author (ESRO)

N68-23267# ARO, Inc., Arnold Air Force Station, Tenn.
EFFECTS OF NONEQUILIBRIUM AND MASS TRANSFER ON A BLUNT OGIVE PRESSURE DISTRIBUTION Final Report, 1 Nov.–31 Dec. 1967
Clark H. Lewis, John C. Adams, Jr., H. S. Brahinsky et al Arnold Eng. Develop. Center Mar. 1968 19 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-31; AD-666910)

Pressure distributions over a spherically blunted ogive were computed for perfect (gamma = 1.4) gas, equilibrium air, and nonequilibrium inviscid outer flow fields with nonreacting and reacting boundary-layer flow fields. The effects of surface mass transfer and displacement were also included in the nonreacting flow field studies. The results show that for a short (15 nose radii), blunt body at the altitude and velocity conditions considered, the effects of (inviscid and viscous) chemistry on the surface pressure distributions were from about 10 to 20 percent, and the effects of displacement and mass transfer were less than 10 percent in general. Author (TAB)

N68-23313*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STATIC AERODYNAMIC CHARACTERISTICS OF BLUNTED CONES IN THE MACH-NUMBER RANGE FROM 2.2 TO 9.5
Billy Walker and Robert W. Weaver 1 Dec. 1967 174 p refs
(Contract NAS7-100)
(NASA-CR-94553; JPL-TR-32-1213) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental investigation of the effects of shape parameters on blunted-cone aerodynamic characteristics was conducted in the JPL wind tunnels. The varied parameters were cone half angle, nose radius, and edge radius. The test conditions which were varied were Mach number and Reynolds number. This report presents a summary of the results in the form of axial force coefficient, normal force coefficient slope, and center of pressure location, all at zero angle of attack. A complete set of all data plotted vs angle of attack is included in this report. Author

N68-23344# ARO, Inc., Arnold Air Force Station, Tenn.
OBSERVATIONS ON THE INFLUENCE OF AMBIENT PRESSURE ON BOUNDARY-LAYER TRANSITION Final Report, 1 Mar.–31 Oct. 1967

J. Leith Potter Arnold Eng. Develop. Center Mar. 1968 23 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-36; AD-666911)

For at least 15 yrs it has been known that the Reynolds number characterizing transition form laminar to turbulent boundary-layer flow (based on local properties and wetted length to transition) may be influenced by the local unit Reynolds number or some still unidentified, related quantity under both subsonic and supersonic conditions. Because examples of this were available almost exclusively from wind tunnel work, and because of the possibility that free-stream disturbances were responsible, there has been uncertainty as to whether the so-called unit Reynolds number effect exists in atmospheric free flight. The study described in the report was conducted in a free-flight range, thereby circumventing wind tunnel effects, and it has resulted in a demonstration of the variation of transition Reynolds number with range pressure (or unit Reynolds number) under conditions of fixed Mach number and average wall temperature ratio. Some preliminary measurements of sound pressures in the range air are reported for comparison with published results for wind tunnels. Author (TAB)

N68-23391*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
AN EXPERIMENTAL STUDY OF THE ENTROPY LAYER SURROUNDING A BLUNT BODY AT ANGLE OF ATTACK Final Report
J. Xerikos and W. A. Anderson Oct. 1967 73 p refs
(Contract NAS7-461)
(NASA-CR-94481; DAC-60804) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental investigation of three dimensional blunt body shock layer phenomena was conducted at a Mach number of 4.468 and at angles of attack up to 20° using an ellipsoid of revolution and an Apollo type model. The principal objective of the study was to investigate the behavior of the stagnation streamline in asymmetric flow by means of a definitive measurement of the isentropic total pressure on the surface of the body. A traversing probe was used to establish accurate total pressure profiles which could then be extrapolated to the body surface. The effect of asymmetry on the measured values was found to be of the order of 0.5% indicating that the maximum entropy streamline does not, in general, coincide exactly with the stagnation streamline. In addition to the shock layer total pressure profiles, detailed surface pressure, shock shape and sonic line data were obtained. Author

N68-23512* National Aeronautics and Space Administration, Washington, D. C.
THEORETICAL AND EXPERIMENTAL CONTRIBUTION TO THE STUDY OF BOUNDARY-LAYER CONTROL [CONTRIBUTION THEORIQUE ET EXPERIMENTALE A L'ETUDE DU CONTROLE DE LA COUCHE LIMITE PAR SOUFFLAGE]
P. Carrier, E. Eichelbrenner, and Ph. Poisson-Quinton May 1968 43 p refs Transl. into ENGLISH from French Presented at the 1st Intern. Congr. of the Aeron. Sci., Madrid, 8 Sep. 1958
(NASA-TT-F-11675) CFSTI: $3.00 CSCL 01A

The experimental analysis of the behavior of incompressible bi-dimensional flow around a wing equipped with a trailing-edge flap deflected at a large angle and permitting a suction face blowing with a variable coefficient of momentum is considered. Certain fundamental experiments bearing on the behavior of a velocity profile in the case of a jet emitted along a wall either in exterior uniform flow or in non-uniform flow lead to a diagram of the mixing process and a tentative adaptation of the classical theory of jets in the complex case considered here. The mathematical solution is obtained through step-by-step integration either with the aid of the finite differences method or by a method utilizing the Karman integral equation. Some practical rules anticipating the performances of a wing equipped with a blowing apparatus on the flap are discussed. Author

N68-23660*# Rice Univ., Houston, Tex.
VARIATIONAL APPROACH TO CONICAL BODIES HAVING MAXIMUM LIFT-TO-DRAG RATIO AT HYPERSONIC SPEEDS
Yo-Yi Huang 1967 32 p refs
(Grant NGR-44-006-063)
(NASA-CR-66628; AAR-35) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation of the lift-to-drag ratio attainable by a slender, conical body flying at hypersonic speeds is presented under the assumptions that the pressure distribution is modified Newtonian and the surface-averaged friction coefficient is constant. The length of the body and the elongation ratio of the cross section are prescribed, and the values of the free-stream dynamic pressure, the factor modifying the Newtonian pressure distribution m, and the surface-averaged friction coefficient are known a priori. The indirect methods of the calculus of variations are employed, and it is found that, for any given value of the length and the elongation ratio, the optimum transversal contour is a diamond shape. As the elongation ratio increases, the maximum lift-to-drag ratio increases. Author

N68-23874 ARO, Inc., Arnold Air Force Station, Tenn.
METHOD OF CALCULATING THE WIND TUNNEL INTERFERENCE FOR STEADY AND OSCILLATING WINGS IN TUNNELS OF ARBITRARY WALL CONFIGURATION Final Report, Jun.–Dec. 1967
C. F. Lo Arnold Eng. Develop. Center Mar. 1968 35 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-42; AD-667187)

A method of calculating the wind tunnel interference induced by arbitrary wall configurations has been developed wherein a linearized equation of the perturbation velocity potential is used to describe the flow in the tunnel. A series solution of the interference velocity potential satisfies the differential equation exactly. The constant coefficients in the series solution are determined by the point matching technique along the boundary. Results are presented for slotted tunnel walls with homogeneous boundary conditions. Solutions presented show excellent agreement with the results obtained by other methods for a stationary as well as an oscillating wing. Finally, the method is applied to compute a set of zero interference configurations for a combination of slot openings of side walls, roof, and floor. Author (TAB)

N68-23929# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
MEASUREMENT OF FLOW SPEED AND FLOW DIRECTION BY AERODYNAMIC PROBES AND VANES
W. Wuest Jun. 1967 39 p refs Presented at the 30th Flight Mech. Panel Meeting, Montreal, 30 May–2 Jun. 1967
CFSTI: HC $3.00/MF $0.65

After defining some quantities having the dimensions of pressure, in subsonic and supersonic flow, different types of Pitot probes, static probes, Pitot-static probes and flow direction probes including vanes are discussed. Special attention is given to the probes and flow direction sensors which are especially suited for flight tests. The corrections due to deviations of flow direction, pressure gradients, neighbourhood of wall and position, low density, Mach number and turbulence are discussed in detail. Author

N68-23937# Princeton Univ., N. J. Gas Dynamics Lab.
AN INVESTIGATION OF HYPERSONIC AERODYNAMICS AT HIGH ALTITUDES
S. M. Bogdonoff *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 20 p refs Supported in part by NSF (See N68-23931 13-34)

Facilities were developed for the study of hypersonic aerodynamics at high altitudes. Using these facilities, an experimental study of flow over simple bodies was initiated. It was found that the classical picture of the low density flow near the leading edge

of a body is not correct. The merging of the shock wave and the boundary layer at a distance of approximately 500 mean free paths from the leading edge results in major deviations from continuum hypersonic theory. In the region of merging, the shock wave thickness increases rapidly and the shock strength decreases as the leading edge is approached. Strong effects of leading edge thickness are found down to thicknesses of about 1/5 of a mean free path. Below that value, no changes in the surface pressure or the flow field details occur, and the body may be considered sharp. The general flow field details and the region of deviation from the continuum theories are given for flat plates over a range of angles of attack, wedges, and cones, and provide the basis for the estimation aerodynamic characteristics in a region not heretofore detailed by experimental results. Author

N68-24003# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.

SOME CONSIDERATIONS ON UNCONVENTIONAL FLIGHT TECHNIQUES USING SMALL ASPECT RATIO WINGS

M. G. Chandivert May 1966 42 p refs

(ARL/SM/312) CFSTI: HC $3.00/MF $0.65

It is suggested that a slender planform and use of rapid dynamic effects are significant factors in enabling some birds to perform a dive-landing manoeuvre, and the possibility of employing similar features for the landing of a piloted craft is discussed. The dynamics of a small glider designed around a rigid slender wing is investigated. Equations for response to compatible variations of lift and drag consistent with a rapid change of attitude are solved numerically. The results indicate the theoretical feasibility of low velocity landing manoeuvres requiring little air and ground space. It is suggested that more research needs to be carried out in some related areas before the full potential of such flight techniques can be estimated, and some problems associated with practical developments are noted. Author

N68-24010# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.

STATISTICAL METHODS FOR THE REDUCTION OF DYNAMIC FLIGHT DATA

Gerard J. Born and Enoch J. Durbin [1967] 38 p refs Presented at the 30th Flight Mech. Panel Meeting, Montreal, Canada, Jun. 1967

A compact method is established for the mathematical representation of signal averages resulting from random processes. The description of the data is given by representation in the form of time averages, as frequency averages, and as probabilities. The equivalence of these representations is discussed. Statistical representations are used for describing flight systems in statistical terms. Statistical errors in these basic data representations are discussed. K.W.

N68-24027# National Physical Lab., Teddington (England). Aerodynamics Div.

THE CALCULATION OF THE PRESSURE DISTRIBUTION ON A THICK CAMBERED AEROFOIL AT SUBSONIC SPEEDS INCLUDING THE EFFECTS OF THE BOUNDARY LAYER

B. J. Powell (Kingston Coll. of Technol.) Jun. 1967 32 p refs

(NPL-AERO-1238; ARC-29300) CFSTI: HC $3.00/MF $0.65

This report describes a method for calculating the pressure distribution on the surface of a two-dimensional aerofoil of arbitrary shape in subsonic flow, taking into account the presence of a boundary layer on the surface of the aerofoil. The effect of the boundary layer is accounted for by considering the inviscid flow over a displacement surface made up of the aerofoil section shape, boundary layer displacement thickness and the wake. A simple model of the wake is introduced, and it is shown that provided certain simple conditions are satisfied in the region near the aerofoil trailing edge, the pressure distribution predicted is not unduly sensitive to the detailed development of the wake. The method has been developed using techniques which make it very suitable for computation on a digital computer. Calculations have been made of the pressure distribution on a RAE 101 aerofoil section an incidence for which measured boundary layer data were available, and also in the case of a heavily cambered aerofoil at incidence using theoretically predicted boundary layer characteristics. The comparison between the experimental and predicted pressure distributions shows good agreement in both cases. Author (ESRO)

N68-24131# National Physical Lab., Teddington (England). Aerodynamics Div.

ESTIMATION OF SURFACE PRESSURES FROM OBSERVED SHOCK-WAVE ENVELOPES SURROUNDING CONICAL BODIES AT M = 4.0

M. J. Larcombe 16 Aug. 1967 18 p refs

(NPL-AERO-1244; ARC-29349) CFSTI: HC $3.00/MF $0.65

An optical method utilizing a standard schlieren system is used to locate the position of the shock wave surrounding a conical body at a free stream Mach number of 4.0. An analysis of the conditions at the shock wave enable the surface pressure distribution to be calculated. Good agreement with experimental pressure distributions is obtained except in regions dominated by viscous effects. Author (ESRO)

N68-24171# ARO, Inc., Arnold Air Force Station, Tenn.

HIGHER ORDER BOUNDARY-LAYER EFFECTS ON ANALYTIC BODIES OF REVOLUTION Final Report, Sep. 1966–Sep. 1967

John C. Adams, Jr. Arnold Eng. Develop. Center Apr. 1968 56 p refs

(Contract AF 40(600)-1200)

(AEDC-TR-68-57; AD-667523)

Results are presented from an investigation into second-order compressible boundary-layer theory applicable to blunt bodies formulated for numerical solution in the transformed plane using an implicit finite difference scheme. Various combinations of second-order effects (external vorticity, displacement, transverse curvature, longitudinal curvature, slip, and temperature jump) are considered for two different bodies: a paraboloid and a hyperboloid of 22.5-deg asymptotic half-angle, in a Mach 10 perfect gas flow under low Reynolds number conditions. It is shown that one should properly interpret second-order vorticity and displacement in a combined sense as a vorticity-displacement interaction; numerical results indicate that such interaction is the dominate second-order effect on the bodies under consideration, especially for the hyperboloid where it becomes a first-order effect. Caution is advised in the application of second-order theory to such bodies since the asymptotic matching conditions between inner and outer flow fields may not remain valid as the boundary layer grows while the external vortical (entropy) layer decreases in thickness. Author (TAB)

N68-24264# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POWER MACHINERY MANUFACTURE

26 Sep. 1967 23 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 1, 1966 p 21–22, 28–30

(FTD-HT-67-52; AD-666739)

Contents: Determination of the critical velocities of hydraulic turbine shafts; The effect of radial clearance on turbine performance. TAB

N68-24333# Royal Aircraft Establishment, Farnborough (England).
CALCULATION OF THE INCOMPRESSIBLE FLOW ABOUT THICK WING AND CASCADE PROFILES WITH TAPERED TRAILING EDGES [BERECHNUNG DER INKOMPRESSIBLEN STROEMUNG UM DICKE TRAGFLUEGEL- UND GITTERPROFILE MIT ECKIGER HINTERKANTE]
Klaus Jacob Jan. 1968 19 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 15, nos. 8/9, 1967
(RAE-LIB-TRANS-1276) CFSTI: $3.00

E. Martensen's well-known singularity method for computing incompressible potential flow about single aerofoils or cascades is extended to profiles with tapered trailing edges. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-23128# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A METHOD FOR PREDICTING THE TRIM CONSTANTS AND THE ROTOR-BLADE LOADINGS AND RESPONSES OF A SINGLE-ROTOR HELICOPTER Final Report, Feb. 1966–Jul. 1967
T. T. Chang Nov. 1967 107 p refs
(Contract DA-44-177-AMC-384(T))
(CAL-BB-2205-5-1; USAAVLABS-TR-67-71; AD-666802)

The present effort was undertaken to extend the previously developed method by (1) including the blade inplane and torsional motions, and (2) treating the four trim constants (namely, the blade pitch-control settings and the rotor-shaft tilt angle) as unknowns. The trim constants are different for different flight conditions and are determined through the use of four appropriate, average equilibrium conditions of the helicopter. These equilibrium conditions are called the trim equations and are derived in the report, taking into account the inertial forces of the blades due to elastic deformations. Lagranges equations for the blade motions are given. The generalized coordinates employed in these equations to represent blade bending are those which have deflection components in two mutually perpendicular directions. Orthogonality relations of vibration modes of twisted, rotating blades are derived and are used in simplifying the equations of blade motion. A successive approximation procedure was developed which, upon incorporation with the previously developed iterative procedure, yields the aerodynamic loads, the blade responses, and the required trim constants. Computed results are obtained for the UH-1A rotor at advance ratios of 0.26 and 0/08 and for the H-34 rotor at advance ratios of 0.29 and 0.18. Comparisons of these results with available measured results are presented. Author (TAB)

N68-23135# Systems Technology, Inc., Hawthorne, Calif.
ANALYTICAL REVIEW OF MILITARY HELICOPTER FLYING QUALITIES Final Report
R. P. Walton and I. L. Ashkenas Washington Naval Air Systems Command Aug. 1967 196 p refs
(Contract NOw-64-0601-f)
(STI-TR-143-1; AD-666827)

The report is directed at analysis and review of the current military helicopter flying qualities specification, MIL-H-8501A, and of the relevant published literature. The analytical approach rests primarily on servo-analysis of closed-loop piloting tasks and secondarily on open-loop response considerations, and such analysis and considerations are used as the basis for correlating and explaining the available data. This process delineates those flying qualities criteria (either in the specification or proposed in the literature) which are valid, and establishes bases for additional experiments in inadequately explored critical areas. The results are specifically applied to an itemized critique of MIL-H-8501A (excluding autoration, miscellaneous, instrument flight, and vibration characteristics). Author (TAB)

N68-23167# Sylvania Electric Products, Inc., Buffalo, N. Y.
VALUE ENGINEERING. LIGHT OBSERVATION HELICOPTER AVIONICS PACKAGE Final Report, 21 Jan. 1966–21 Jan. 1968
James B. Allis Jan. 1968 16 p refs
(Contract DA-28-043-AMC-01943(E))
(ECOM-01943-7; AD-666792)

Accomplishments achieved during the report period are summarized. The following topics are included: Program Management Office, time expended, inherent value engineering changes, subcontractors, VE training and orientation, advance production engineering, and recommendations. TAB

N68-23197# Boeing Co., Renton, Wash. Commercial Airplane Div.
STATE OF THE ART IN DESIGN AND TESTING TO ENSURE CONTINUED AIRCRAFT STRUCTURAL INTEGRITY
A. C. Larsen and R. E. Watson 4 Nov. 1966 14 p Presented at the FAA Symp. on Continued Reliability of Transport Type Aircraft Struct., Washington, D. C., 2–4 Nov. 1966
(AD-667149)

The paper reviews recent advancements in the design and testing of modern commercial jet aircraft structures as viewed by an American manufacturer. Advancements are continually being made in structural criteria, methods of analysis, materials and processes, structural testing, and the use of fleet experience. Each of these areas is discussed and examples are presented to show how these advancements are employed to ensure continued structural integrity of aircraft. Author (TAB)

N68-23310# American Power Jet Co., Ridgefield, N. J.
COMPARATIVE ANALYSIS OF ARMY AVIATION MAINTENANCE CONCEPTS
Sep. 1967 237 p
(Contract DA-42-092-ARO-161)
(APJ-483-2; AD-666745)

The objective of the study is to accomplish, in the context of recent Army experience in Vietnam, a comparative evaluation of the three principal concepts of direct support level aircraft maintenance: (1) the conventional direct support (DS) concept as employed by the Road Infantry Divisions, (2) the airmobile concept as employed by the 1st Cavalry Division (Airmobile), (3) the DS Detachment concept as practiced in the aviation companies of the 1st Aviation Brigade. Findings and recommendations derived from this evaluation are furnished to provide bases for decisions on the optimum concepts for this important aspect of management of army aviation resources. These concepts are analyzed in terms of: (1) effectiveness, as reflected in reported aircraft readiness and utilization, (2) efficiency of support operations as indicated by norm (not operationally ready, maintenance) rates, NORS (not operationally ready, supply) rates, supply performance and ratio of manpower to aircraft supported, (3) investments in resources to include equipment, personnel, facilities, and parts stockage. The report describes the structure of the problem, the evaluation parameters, and the results of the analysis. Author (TAB)

N68-23315*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INITIAL REPORT ON OPERATIONAL EXPERIENCES OF GENERAL AVIATION AIRCRAFT
Joseph W. Jewel, Jr. 5 Apr. 1968 50 p refs Presented at SAE Natl. Business Aircraft Meeting, Wichita, Kans., 3–5 Apr. 1968
(NASA-TM-X-61082) CFSTI: HC$3.00/MF$0.65 CSCL 01C

An analysis has been made of 27,000 hours of VG and VGH data obtained from 62 general aviation aircraft based throughout the United States. Comparisons are made between the actual flight loads experienced by aircraft engaged in five types of operations and the design flight envelopes for these aircraft. Gust and maneuver acceleration fractions, relating actual load factors to design load factors, are indicated. Airspeed and altitude operating practices are shown for the various aircraft. Landing impact acceleration distributions and a limited sample of accelerations measured during individual, practice, and competitive aerobatics are presented. Author

N68-23322* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AIRBORNE PLATFORM MEASUREMENTS
Michel Bader 9 Feb. 1968 21 p Presented at the Eclipse Sym., Sao Jose Dos Campus, Brazil, 5–9 Feb. 1968
(NASA-TM-X-61079) CFSTI: $3.00 CSCL 01C

Capabilities for scientific research are described for jet aircraft which operate at altitudes of 33,000 ft or higher, with primary emphasis on the aircraft operated at NASA's Ames Research Center and application related to astronomy. Some jet aircraft regularly used for scientific research in the United States are listed along with their typical speeds and ranges and their ceiling altitudes. A listing of programs conducted with the NASA CV-990 jet aircraft is included; and two means of image stabilization are illustrated, both of which could be refined to yield ±2 to 5 arcmin stability. Overhead water vapor measurements are shown, and noctilucent and mother of pearl clouds above 50 deg lat are plotted for various tropopause altitudes. Solar spectra are graphed at various altitudes, the sky spectrum and theoretical water vapor spectrum is shown at 12 km altitude, and some Venus and lunar spectra are plotted. Atmospheric transmittance from space to 38,000 ft is graphed for the ultraviolet and visible regions, and relative coronal and sky intensities are plotted. M.W.R.

N68-23443# Qantas Empire Airways Ltd., Sydney (Australia)
STRUCTURAL INSPECTION PROGRAMS
Robert H. Stevens Nov. 1966 16 p
(AD-667147)

The paper discusses structural sampling inspections in inspecting a fleet of Boeing 707 aircraft. At the present time the total Boeing fleet consists of nineteen aircraft, which are again subdivided into thirteen type 707-138B and six type 707-338C aircraft. Author (TAB)

N68-23456*# National Aeronautics and Space Administration, Washington, D. C.
HELICOPTERS—CALCULATION AND DESIGN. VOLUME 2: VIBRATIONS AND DYNAMIC STABILITY
M. L. Mil' et al May 1968 484 p refs Transl. into ENGLISH of the book "Vertolety. Raschet i Proyektirovaniye. 2. Kolebaniya i Dinamicheskaya Prochnost" Moscow, Mashinostr. Press, 1967 p 1–470
(NASA-TT-F-519) CFSTI: HC$3.00/MF$0.65 CSCL 01C

This volume contains theory and problems of vibration, stress calculations for helicopters in flight, and particularly stress calculations for rotor blades. Covered are methods for calculating structural fatigue and vibrational amplitudes. The problem of coupled vibrations of rotor and fuselage is examined. The self-excitation phenomenon of ground resonance is discussed in detail for helicopters on the ground, during takeoff and landing, and during cruising flight. Theory and calculation methods are presented for analyzing bearing loads of major helicopter components under various operating conditions. K.W.

N68-23514*# Scripta Technica, Inc., Washington, D. C.
PROBLEM OF OPTIMUM COMMANDS OF A VERTICAL TAKE-OFF AIRCRAFT [SUR LE PROBLEME DES COMMANDES OPTIMALES D'UN AVION A ESSOR VERTICAL]
T. Hacker Washington NASA May 1968 28 p refs Transl. into ENGLISH from Rev. Roumaine Sci. Tech., Ser. Mecan. Appl. (Rumania), v. 2, no. 3, 1966 p 659–682
(Contract NASw-1694)
(NASA-TT-F-11636) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Discussion of the control laws which will provide attainment of a prescribed altitude and acceleration to a prescribed speed in minimum time or minimum fuel consumption, for a VTOL aircraft. Some considerations of the command variables are given, involving a generalized theory of this concept and guidelines for using this theory to construct a mathematical model. The statement of optimum problems is examined for aircraft with and without thrust control, using the couple of the longitudinal command, the magnitude and direction of the thrust, the angle of attack, and the inclination of the velocity vector to the horizon as the command variables. The results are used to define the arcs of which the optimum trajectories are composed. Author

N68-23534*# Techtran Corp., Glen Burnie, Md.
EFFECTS OF THE FLIGHT SPEED OF PASSENGER AIRCRAFT ON FLIGHT NOISE AND OF THE NOISE DURATION ON SUBJECTIVE ESTIMATES OF NOISE INTENSITY [VLIYANIYE SKOROSTI POLETA NA PROLETNYY SHUM PASSAZHIRSKIKH SAMOLETOV I PRODOLZHITEL'NOSTI SHUMA NA SUB'EKTIVNUYU OTSENKU EGO INTENSIVNOSTI]
G. I. Gubkina and B. N. Mel'nikov Washington NASA May 1968 7 p refs Transl. into ENGLISH from Akust. Zh. (USSR), v. 13, no. 4, 1967 p 562–566
(Contract NASw-1695)
(NASA-TT-F-11741) CFSTI: HC$3.00/MF$0.65 CSCL 01C

A discussion is presented of the aircraft noise problem, based on noise observations of Soviet domestic passenger aircraft and the Caravelle aircraft. Graphs of noise levels versus aircraft speed are plotted, and an empirical formula is presented which takes noise duration into account. The results for noise levels as a function of flight speed are believed to be applicable to all jet-powered passenger aircraft, and in the first approximation to turboprops as well, even though they largely based on observations in the TU-104 and TU-124 aircraft. Author

N68-23761# Advisory Group for Aerospace Research and Development, Paris (France).
ASPECTS OF V/STOL AIRCRAFT DEVELOPMENT
Sep. 1967 120 p refs Presented at Joint Session of AGARD Fluid Dyn. and Flight Mech. Panels, Goettingen, West Ger., 13 Sep. 1967
(AGARD-Advisory-13) CFSTI: HC$3.00/MF$0.65

Three survey papers are presented in this report which cover the following: (1) problems associated with helicopter rotor aerodynamics and aerodynamic performance, range, and speed of several VTOL configurations; (2) VTOL propulsion technology, including fuel consuption in cruising flight, specific weight, specific volume, gas turbine engine technology, and engine efficiency; and (3) flight mechanics aspects of VTOL development, including technologies applicable to conventional and VTOL flight modes, technological gaps, effects of vehicle configuration characteristics, and propulsion system integration. K.W.

N68-23763# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
INVESTIGATION OF TURBOPROP ENGINE CHARACTERISTICS DURING BIRD INGESTION Final Report
Donald M. Millar Apr. 1968 20 p refs
(NA-68-6)

Tests were conducted to determine specific reactions to the ingestion of small birds by a free turbine turboprop engine. Transient and steady-state engine performance was monitored and recorded during and following ingestion sequences. In general, a deterioration in engine performance was indicated upon ingestion of birds or portions thereof. Subsequent engine recovery and stabilization to operating levels below preingestion values were attained in periods from 2 to 4 seconds. Operating levels were reduced as much as 50 percent and were in general a function of the quantity of starlings which entered the inlet duct. Following multiple bird ingestion tests, the degree of inlet blockage prevents preingestion power levels from being attained. No evidence of engine flameout was recorded during any of the 16 test runs, nor was any autofeathering signal indicated. There was no visible damage sustained by the engine. Author

N68-23811# General Dynamics/Convair, San Diego, Calif.
DESIGN STUDY AND MODEL STRUCTURES TEST PROGRAM TO IMPROVE FUSELAGE CRASHWORTHINESS Final Report
D. L. Greer, T. L. Heid, and J. D. Weber Oct. 1967 127 p refs
(Contract FA-67-WA-1541)
(DS-67-20; AD-666816)

The study was performed to evaluate methods of improving fuselage cabin integrity during crash impact loadings. The report includes: (1) analytical studies to determine the axial and lateral energy absorbing capability and collapse effects of typical fuselage structure, (2) a test program using representative sections of fuselage structure to substantiate the analytical studies and (3) a digital computer program to obtain fuselage dynamic response in a crash impact. Author (TAB)

N68-23875 New York Univ., N. Y. School of Engineering and Science.
ON A CAUSE OF FAILURE OF HIGH ALTITUDE PLASTIC BALLOONS
Arnold D. Kerr and Harold Alexander Oct. 1967 13 p refs
(Contract F19628-67-C-0241)
(NYU-AA-67-111; AFCRL-67-0611; SR-2; AD-667192)

In a search for causes of failure of plastic balloons, an experiment which simulates the stresses and temperatures in part of a balloon during launch and ascent was conceived and then tests using a number of balloon films were conducted. It was found that because of uni-axial preloading at +75F (launch temperature), the strength of the film from the final production lot of DFD-5500 deteriorates strongly at -70F (Troposphere temperature), whereas the strength of StratoFilm is unaffected by it. Since this finding agrees with the flight records of balloons made of these materials it is suggested that before a plastic film is accepted as balloon material it should also be subjected to tests of the type discussed in the present paper. Author (TAB)

N68-23895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TANKAGE SYSTEMS FOR A METHANE-FUELED SUPERSONIC TRANSPORT
Joseph D. Eisenberg and Rene E. Chambellan Washington May 1968 21 p refs
(NASA-TM-X-1591) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The use of liquid-methane fuel promises economic improvement, but its cryogenic nature causes on-board storage problems. Should the fuel be loaded in a saturated condition, much fuel will flash off due to pressure reductions during climb. Pressurized tanks or subcooled fuel will solve this problem. Subcooled fuels require a pressurizing gas. Low solubility gases have low availability and must be salvaged. Bladders or stand-pipes to reduce the contact area may be used with soluble or condensible pressurizers. Analytical studies indicate that these methods, when used separately or in combination, offer potential solutions to the tankage problem. Author

N68-23901*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A REVIEW OF TRANSPORT HANDLING-QUALITIES CRITERIA IN TERMS OF PRELIMINARY XB-70 FLIGHT EXPERIENCE
Bruce G. Powers Washington May 1968 33 p refs
(NASA-TM-X-1584) CFSTI: HC $3.00/MF $0.65 CSCL 01C

A preliminary flight evaluation of handling qualities of the unaugmented XB-70 airplane was made during the initial flight test and envelope-expansion program. The evaluations consisted of pilot ratings and comments on the longitudinal and lateral-directional characteristics. The pilot ratings were compared with several current handling-qualities criteria for transport aircraft to establish the applicability of these criteria to this class of airplane. The results of the study show that for the longitudinal mode fair correlation was obtained between the XB-70 handling qualities and specific criteria boundaries based on the short-period frequency and damping. It appears that a combination of many handling-qualities factors on the XB-70 airplane obscured the effects of any single handling-qualities parameter. These factors include excessive yaw due to aileron input, restricted sideslip limits, poor pitch and roll control harmony, and poor attitude and heading information. Author

N68-23921# National Research Council of Canada, Ottawa (Ontario).
AN AIRSPEED MEASURING SYSTEM FOR HELICOPTERS
D. F. Daw Jan. 1967 29 p refs Presented at 30th AGARD Flight Mech. Panel on Flight Test Instrumentation, Montreal, 30 May–2 Jun. 1967
(NAE-MISC-44)

An airspeed system giving outputs proportional to longitudinal and lateral components of airspeed was developed for use on variable stability helicopters. The system shows promise of more general use on rotorcraft where it is not desirable to install slip rings on the main rotor shaft. Pitot probes mounted at the tips of both main rotors are used in the system. Principles of operation, components, and calibration are described. K.W.

N68-23995# Dynasciences Corp., Blue Bell, Pa.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE INSTANTANEOUS INDUCED VELOCITY FIELD IN THE WAKE OF A LIFTING ROTOR Final Report
N. Miller, J. C. Tang, and A. A. Perlmutter Jan. 1968 172 p refs
(Contract DA-44-177-AMC-383(T))
(DCR-227; USAAVLABS-TR-67-68; AD-667384)

Measurements have been made of the instantaneous and time-averaged values of the induced velocities in the wake of a full-scale helicopter in actual steady flight conditions. These measurements were made with three-dimensional pitot static and two-dimensional hot film probes. The test setup provided for measurements at several radial, axial, and azimuthal positions relative to the rotor centerline. Simple, analytical methods are formulated to predict the instantaneous and time-averaged, induced velocities in the rotor wake. Calculated values of the induced velocities are compared with the experimental data, and agreement is obtained for the hovering flight condition. Author (TAB)

N68-24022# Center for Naval Analyses, Washington, D. C. Inst. of Naval Studies.
THE ASSIGNMENT OF AIRCRAFT TO THE NAVAL ADVANCED JET PILOT TRAINING MISSION Interim Report
A. James Boness and Arnold Schwartz Nov. 1967 49 p ref
(Contract N00014-68-A-0091)
(INS-RC-23; AD-667574)

This paper is an interim report on methods of solving aircraft service life problems. It is specifically concerned with the immediate problem of whether F-9J aircraft should be overhauled or replaced. The method used calculates present values of differential costs of four alternative retirement policies. Recommendations are made for phasing in replacement aircraft at particular rates and beginning at particular times. Author (TAB)

N68-24023 Goodyear Aerospace Corp., Akron, Ohio.
WIND TUNNEL TESTS OF NATURAL SHAPE BALLOON MODEL
Paul A. Sherburne 9 Mar. 1968 46 p refs
(Contract F19628-67-C-0145; ARPA Order 755)
(GER-13731; AFCRL-68-0123; SR-1; AD-667563)

To further the development of high-altitude tethered balloons, wind tunnel testing of a rigid model of a natural shape balloon was performed. The rigid model tested represented a shape with top loading F/p = zero, superpressure parameter alpha = 0.9315, and Sigma = 0.0315. Aerodynamic data obtained in the 12-foot pressure tunnel include lift, drag, pitching moment, and surface pressure distribution for the Reynolds number range of 450,000 to 12 million. Examination of the data indicates that (1) stall occurs at a positive angle of attack less than 10 degrees, (2) an aerodynamic unstable trim point occurs between 5 and 15 degrees angle of attack, and (3) the drag at zero degrees angle of attack is greater than that of a sphere at the same Reynolds number. Author (TAB)

N68-24231 RAND Corp., Santa Monica, Calif.
JET FIGHTER ACCIDENT/ATTRITION RATES IN PEACETIME: AN APPLICATION OF RELIABILITY GROWTH MODELLING
Milton Kamins Mar. 1968 38 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5563-PR; AD-667784)

Two statistical examinations were made of accident and attrition data for all jet fighters that had seen substantial Air Force usage by 1963: the first to distinguish gross factors affecting safety (landing speed, single versus twin engines, similarity to a previous model, and age); the second to compare different methods for analysis and prediction. The first examination showed that (1) aircraft reliability affecting safety improves with years of service as long as routine, comprehensive maintenance and product improvement programs are pursued; (2) during the last 20 years, materiel failures have become more important in jet fighter accidents; (3) two engines may be no more beneficial to safety than a heavy carry-over of technical experience from one model to the next made by the same company; (4) landing speed is less important than either. The second examination confirmed these conclusions and also indicated that the hyperbolic model of reliability growth developed in RM-5346-PR is preferable to a learning-curve model in three respects: it can represent trends more accurately, is easier to use, and permits statistically and practically meaningful confidence limits to be calculated for past experience or future projections of accident or attrition rates. Author (TAB)

N68-24242# Sandia Corp., Albuquerque, N. Mex.
MEASUREMENTS OF LIGHTNING STRIKES TO AIRCRAFT Final Report
B. J. Petterson and W. R. Wood Jan. 1968 151 p refs
(Contracts FA-65-WAI-94; FA-66-NF-AP-12)
(SC-M-67-549; DS-68-1)

Primary interest was in the effect of lightning on nuclear weapons and on aircraft and missile wiring. A description of the test instrumentation, its installation in the aircraft, and an analysis of the results obtained is given. Flights were made into thunderstorms off the coast of Florida. Strikes were photographed and recorded, and the information was later analyzed. Although certain trends in effects were noted, no specific conclusions have been drawn. Further tests will be necessary to permit definition and reproduction of the lightning current signature. Author

N68-24245*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST OF A 40-FOOT NOMINAL DIAMETER DISK GAP BAND PARACHUTE DEPLOYED AT A MACH NUMBER OF 1.91 AND A DYNAMIC PRESSURE OF 11.6 POUNDS PER SQUARE FOOT
John S. Preisser and Clinton V. Eckstrom Washington May 1968 38 p refs Film supplement number L-1000 to this report is available on loan from NASA, Langley Res. Center
(NASA-TM-X-1575) CFSTI: HC $3.00/MF $3.00/MF $0.65 CSCL 01C

A 40-foot nominal-diameter disk-gap-band parachute was flight tested. The test parachute was ejected by a deployment mortar from an instrumented payload at an altitude of 140,000 feet. The payload was at a Mach number of 1.91 and the dynamic pressure was 11.6 pounds per square foot at the time the parachute deployment mortar was fired. The parachute reached suspension line stretch in 0.43 second with a resultant snatch force loading of 1990 pounds. The maximum parachute opening load of 6500 pounds came 0.61 second later at a total elapsed time from mortar firing of 1.04 seconds. The first full inflation occurred at 1.12 seconds and stable inflation was achieved at approximately 1.60 seconds. The parachute had an average axial-force coefficient of 0.53 during the deceleration period. During the steady-state descent portion of the flight test, the average effective drag coefficient was also 0.53 and pitch-yaw oscillations of the canopy averaged less than 10° in the altitude region above 100,000 feet. Examination of the recovered parachute revealed that it was not damaged during the flight test. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-23140# Army Electronics Labs., Fort Monmouth, N. J.
POWER SOURCES FOR ELECTRIC CARS
Galen R. Frysinger Jan. 1968 42 p
(ECOM-2929; AD-666773)

An extrapolation, based on extensive experience with battery and fuel cell power sources during various Army programs, is made into the future world of the electric car and speculates on the power sources most suited as the electrical energy source. The conclusion is that both the battery and the fuel cell have their place when combined uniquely in a hybrid configuration which by proper design can provide outstanding characteristics. Author (TAB)

N68-23182*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
POWER GENERATION AND CRYOGENIC GAS STORAGE SYSTEMS STUDY FOR POST AAP 1-4 MANNED MISSIONS

Tony E. Redding, ed. 3 Aug. 1967 54 p
(NASA-TM-X-61072; MSC-IN-67-EP-24) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A study of possible electrical power generation systems (PGS) and cryogenic gas storage systems (CGSS) for the Apollo Applications (AAP) missions is summarized. Ground rules and guidelines affecting PGS and CGSS requirements were investigated; and attention was given to missions and configurations, power, and CGSS requirements as well as weights and payload margins. Candidate hardware were studied for the cryogenic gas storage systems, fuel cells, solar cell/battery systems, primary and secondary batteries, and power conditioning. Design and analysis for the PGS and CGSS included hybrid power system, command-service module fuel cell/radiator heat rejection system, and orbital storage considerations. Scheduling, costs, and programming considerations are summarized. M.W.R.

N68-23242# AiResearch Mfg. Co., Los Angeles, Calif.
UNINTERRUPTIBLE POWER SYSTEM MODULE ANALYSIS Interim Report
E. R. Pledger Nov. 1967 74 p
(Contract FA-67-WA-1748)
(RD-67-62; AD-666823)

A module analysis was conducted to determine the optimum rating of module which, together with identical modules, would best satisfy the contractual requirements for an uninterruptible ac power (u-p) supply system for use in Federal Aviation Administration (FAA) Air Route Traffic Control Centers. In determining the optimum module output capacity, due consideration was given to incurring the lowest initial and recurring cost over a 10-year period, the possibility of future u-p supply installations at 18 other centers in addition to the present Islip, N.Y., installation under contract with regard to (1) their initial critical load magnitudes (98-381 kva); (2) ultimate loads of 500 kva; (3) ultimate loads of a presently indeterminable kva; and (4) the interchangeability of modules between Air Route Traffic Control Centers. Also considered in this analysis was a quantitative economic and operational determination of various module output capacities and module circuit configurations as they relate to critical loads of both a steady state and transient nature, electrical performance, efficiency, redundancy, maintainability, space and future expansion requirements, and reliability requirements. Six basic circuit configurations were investigated at power levels ranging from 50 kva modules to 250 kva modules. Author (TAB)

N68-23262# Burgess Battery Co., Freeport, Ill.
DEVELOPMENT OF MAGNESIUM WAFER CELLS Semiannual Report, 1 May–31 Oct. 1967
Lloyd W. Eaton Feb. 1968 30 p
(Contract DA-28-043-AMC-02135(E))
(ECOM-02135-5; AD-666790)

The principal failure of magnesium bromide batteries has been the degree of corrosion of the magnesium anode on the contact side that progresses under the cell wrap seal and increases the resistance of the contact or destroys the contact. It has been concluded that the presence of air is causing the anode to be attacked on the contact (non-reactive) side to an excessive degree and that the anode in a flat cell needs complete protection on the non-reactive side. Magnesium perchlorate cathode material seems to intensify the action on the non-reactive side of the anode and there is a strong suggestion that the rubber hydrochloride cell wrap is being degraded by the oxidizing nature of the perchlorate at 160F, causing leakage and the destruction of the batteries stored at 160F. Author (TAB)

N68-23320# Lockheed-California Co., Burbank.
TELEPRINTER TT-567/AGC-6 Interim Engineering Report, 25 Aug.–25 Nov. 1967
Carlyne Smith 25 Jan. 1968 32 p
(Contract NOw(A)-66-0039-f)
(P3C-06227-2-2; IER-3; AD-666626)

The C revision to the equipment specification 422800 was released. The present issue of the equipment specification differs from the previous one as follows. The interface signals with the associated equipment are now clarified in greater detail than heretofore, and the reliability tests are now covered by ES422895, Reliability Program Requirements for P-3C Teleprinter TT-567/AGC-6. The slides on the Teleprinter were changed to reflect a new installation of this equipment at the NAV-COMM station which is to mount the teletypewriter and teleprinter on a tray that will ride on rails. Author (TAB)

N68-23346 Stanford Univ., Calif.
PERFORMANCE CHARACTERISTICS OF A COMBUSTION-DRIVEN MAGNETOGASDYNAMIC POWER GENERATOR
Karl Gardner Reseck (Ph.D. Thesis) 1966 232 p
Available from Univ. Microfilms: HC $10.60/MF $3.00 Order No. 67-4421

A magnetogasdynamic generator designed to obtain direct-current electrical power generation data under thermally steady-state conditions operates on the combustion products of ethyl alcohol, oxygen, nitrogen, and KOH seed. The active part of the generator is 19-1/2 inches in length with a cross-sectional area of 1-1/4 inches width by 4 inches transverse height. Thirteen pair of water-cooled molybdenum electrodes insulated by MgO brick form the walls of the gas duct. Flow conditions consist of a stoichiometric mixture with a total mass flow rate of 0.36 kg/sec. Magnetic induction levels of 0, 0.48, 1.36, 2.03 and 2.64 tesla are used. Electron mobility ranges from approximately 0.5 m^2/volt-sec in the hot gas core to 0.1 m^2/volt-sec along the cool electrode surfaces. Gas core temperatures are approximately 2570°K and 2750°K, and estimated wall surface temperatures range from 1000°K on the electrodes to 24°K on the sidewall brick. Test durations in excess of one hour were used. Dissert. Abstr.

N68-23415*# Techtran Corp., Glen Burnie, Md.
THE DETERMINATION OF THE NICKEL-ELECTRODE CAPACITY FROM THE DROP IN POTENTIAL AFTER TURNING OFF THE POLARIZING CURRENT [OPREDELENIYE EMKOSTI NIKELEVOGO KATODA PO SPADU POTENTSIALA POSLE VYKLYUCHENIYA POLYARIZUYUSHCHEGO TOKA]
V. E. Past and Z. A. Lofa Washington NASA May 1968 5 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 106, no. 6, 1956 p 1050–1052
(Contract NASw-1695)
(NASA-TT-F-11672) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The initial part of the potential drop curve recorded within a specified time after turning off the polarizing current is used in determining the capacity of a nickel electrode. An oscillographic apparatus, the operation of which is described, is used. The results of the tests indicate that the capacity of the electrode is independent of potential for a given polarizing current and that capcity is constant within the specified period of time. The results are also in agreement with the experimental results of several other investigators, with the theory that hydrogen atoms are not adsorbed on the surface of a mercury cathode in significant quantities and with the theory that the potential drop of the cathode after the polarizing current is turned off is a function only of the discharge of ions from a binary-layer. The nickel electrode was tested in H_2SO_4 and NaOH solutions. The experimental procedures are described and figures and various reactions are furnished. Author

N68-23468*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN EVALUATION OF PHOTOVOLTAIC DEVICES FOR FUTURE SPACECRAFT POWER DEMANDS
D. W. Ritchie and J. D. Sandstrom 1 May 1968 16 p
(Contract NAS7-100)
(NASA-CR-94556; JPL-TR-32-1268) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The present trend of photovoltaic power systems is toward power levels in excess of 1 kW and specific power levels of 50 lb/kW or less. The workhorse of the photovoltaic systems, to date, has been the silicon solar cell; the largest, to date, in a spacecraft power system has been 4 cm^2. Future systems using photovoltaics may find it advantageous to use devices with greater active area and lighter weight; however, the conventional size cell (2-×2-cm) will probably be the only ones available for the next several years. There are two photovoltaic devices under development that will satisfy larger active area requirements—the cadmium sulphide cell and the dendritic-type silicon cell. Each of these cell developments is approaching a technology level that is nearly competitive with conventional silicon cell capabilities. This paper compares the various cell types and presents discussion as to the the potential advantages or disadvantages of each for system usage. Author

N68-23476*# General Electric Co., Schenectady, N. Y.
CHARACTERISTICS OF A VARIABLE SPACED PLANAR THERMIONIC CONVERTER WITH A TUNGSTEN EMITTER AND A NIOBIUM COLLECTOR
V. C. Wilson and J. Lawrence Washington NASA May 1968 105 p refs
(Contract NAS3-8511)
(NASA-CR-1033) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A parallel plane, variable spaced, thermionic converter was built with a polycrystalline tungsten emitter and a polycrystalline niobium collector. Current-voltage characteristics were obtained for a range of emitter temperatures from 1673 to 2153°K; collector temperatures from 873 to 1173°K; cesium reservoir temperatures from 583 to 683°K, and spacings from 1.0 to 20.0 mils. Over fifty families of curves consisting of over 190 load lines were obtained. Description of the converter processing procedure, test facility and experimental techniques is included. The output characteristics are compared with those of three converters with nickel collectors. Author

N68-23528*# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
MULTI-KILOWATT SOLAR CELL POWER: ITS CRITICAL TECHNOLOGY AND HARDWARE DEVELOPMENT
[1967] 117 p Transcript of Presentation at NASA Headquarters, Washington, D. C., 13 Jul. 1967 Sponsored by NASA
(NASA-CR-94551) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A program review is presented on the critical areas of technology associated with solar cell battery power systems for manned spacecraft. The technical details of what comprises a typical large manned mission solar power system are discussed, and some of the technical problems of large solar cell development are defined. They include (1) adaptability of design approach to orbits, (2) one year reliability goal of 0.995, (3) solar cell constrained to operate belly down, (4) in-orbit thrusting for orbit plane, and (5) flight vehicle envelope constraints. Pictorials and charts are given to graphically illustrate various topics discussed which include system configuration analysis, baseline system analyses, reliability enhancement of baseline system analysis, and selected system configurations. The overall development program for solar cell arrays is examined in relation to total cost of solar array development, development tasks, and the hardware and major elements of the array. B.S.D.

N68-23602*# Bendix Corp., Southfield, Mich. Research Labs.
DESIGN, FABRICATION AND TEST OF A FLUERIC SERVOVALVE
C. E. Vos Feb. 1968 91 p ref
(Contract NAS3-7980)
(NASA-CR-72388; BRL-4220) CFSTI: HC $3.00/MF $0.65 CSCL 13G

Two different models of a pneumatic-input servovalve that operates without the use of moving mechanical parts were designed and fabricated. The servovalve has the output characteristics of a four-way open-centered valve and is designed to operate with either N_2 at room temperature or H_2 at temperatures from 56°K (100°R) to 333°K (600°R), supply pressure of 148 N/cm^2 (215 psia), exhaust pressure of 34.5 N/cm^2 (50 psia), and maximum control pressure of 48.5 N/cm^2 (70.4 psia). This final report presents descriptions of the flueric circuits, component and circuit development, and evaluation test results. Author

N68-23603* Gulton Industries, Inc., Hawthorne, Calif. Engineered Magnetics Div.
APPLIED RESEARCH AND FEASIBILITY STUDIES, EXPERIMENTAL INVESTIGATIONS AND CONCEPTUAL OR PRELIMINARY DESIGN ENGINEERING APPLICABLE TO INVERTERS FOR MOTORS PROGRAM Quarterly Progress Report, Period Ending Mar. 25, 1968
D. B. Irvine 3 Apr. 1968 27 p
(Contract NAS8-20832)
(NASA-CR-61758; Rept.-2194; QPR-3) CFSTI: $3.00 CSCL 09C

A six phase ring-counter was fabricated and tested on an inverter/motor system at several input power levels. Test measurements indicated the following: (1) Maximum efficiency was obtained with a slip of 3 to 5%; (2) the interphase transformer improved efficiency of quasi-square wave motor input operation about 2%, and improved square wave motor input operation 8 to 10%; and (3) quasi-square wave motor input resulted in a more efficient operation than did square wave motor input. System tests at varying motor input frequencies and voltages showed that the slip frequency in Hz must be constant to obtain maximum efficiency. A comparison of test data established optimum slip as 4% (16 Hz), 5% (15 Hz), and 6% (12 Hz), respectively. G.G.

N68-23689# Babcock and Wilcox Co., Barberton, Ohio. Boiler Div.
SODIUM-HEATED STEAM GENERATOR DEVELOPMENT Quarterly Progress Report, Jul.–Sep. 1967
12 Feb. 1967 11 p
(Contract AT(11-1)-1280)
(BAW-1280-48) CFSTI: HC $3.00/MF $0.65

Fabrication of the Prototype Steam Generator was held up pending resolution of metallurgy problems associated with the overheated tube. Recommendations were made for resolution of the problems. Task II, the sodium to steam heat exchanger study, containing preliminary cost trends and preliminary specifications was submitted to the Commission for review and comment. Author (NSA)

N68-23805# General Electric Co., Schenectady, N. Y. Research and Development Center.
MAGNESIUM–AIR BATTERY
C. E. Kent Jul. 1967 4 p
(Rept.-67-C-284)

Development of a 600 watt-hour refuellable primary magnesium–air battery is described. The electrolyte is sodium chloride solution; the anode is a sheet of commercial magnesium alloy; and the cathode is in the nature of the fuel cell air electrodes. Studies to be discussed will include air electrode selection and testing; air flow and cooling; gas venting; structural development; and selection of anode, separator, and electrolyte. As designed, the activated

weight equates to 50 watt-hours per pound and the carry-in weight (no water) for a 30 cycle mission equates to 280 watt-hours per pound. Author

N68-23941# Air Force Academy, Colo. Frank J. Seiler Research Lab.
HIGH ENERGY DENSITY ELECTROCHEMICAL CELLS
L. A. King, A. D. Brown, Jr., and F. H. Frayer *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 17 p refs refs (See N68-23931 13-34)

The oxidation of aluminum in the presence of organic and molten salt electrolytes was studied to determine what electrode processes will be critical in future applications of aluminum anodes in nonaqueous electrolytes. Results of experimental studies of anodic processes of aluminum electrodes immersed in nonaqueous electrolytes, studies of two cell designs, and apparatus used in experimental studies are presented. It is surmised that because the thermodynamically calculated potential is attainable, the electrode polarization is low, and the anode is chemically stable in contact with the electrolyte, aluminum anodes are feasible for practical batteries and fuel cells. S.C.W.

N68-23984# European Space Technology Center, Noordwijk (Netherlands).
SOLAR OUTPUT AS A FUNCTION OF ANGLE OF INCIDENCE FOR BOTH UNPOLARIZED AND LINEAR POLARIZED LIGHT
G. Seibert Paris ESRO Feb. 1968 22 p refs
(ESRO-TM-113(ESTEC) CFSTI: HC $3.00/MF $0.65

The short-circuit current, I_{sc}, of covered and uncovered silicon 'solar' cells was measured at irradiances up to 5 solar constants for different angles of incidence. At high radiation levels I_{sc} increased above the cosine law, indicating that the proportionality between I_{sc} and the light intensity was no longer linear. This deviation is caused by a rather large voltage drop due to the series resistance in the cell. It was observed that, under illumination with linear polarized 'white' light, the angle of the polarizing filter at which the cell output showed a maximum or minimum varied with the angle of incidence. It is shown that this effect, which is independent of the wavelength of the light, is partly caused by the mirror-like silicon-monoxide coating of the solar cell. The cell output illuminated with linear polarized light for a certain direction of the light vector exceeds that given by the cosine law by about 0.8% at an angle of incidence between 45° and 55°. Apparently, the reflectivity has a minimum in this range and is smaller than the reflectivity at normal incidence. Author (ESRO)

N68-23987*# Hittman Associates, Inc., Baltimore, Md.
SOLAR FLAT PLATE Final Report
Oct. 1966 224 p refs
(Contract NAS5-9167)
(NASA-CR-94615; HIT-206) CFSTI: $3.00 CSCL 10A

Solar thermoelectric energy conversion panels may be constructed from modules, each of which consists of an absorber, a thermoelement or thermoelectric couple, and a radiator. The absorber collects solar heat which causes a high temperature to be established. The thermoelements convert a portion of this heat to electricity, and the unconverted heat is rejected to space by the radiator. An accurate analysis has been developed, reported herein, so that the performance characteristics of the solar flat plate may be predicted for expected operational conditions. The mathematical model obtained as a result of this study contains a number of non-linear second order differential equations which cannot be solved analytically. A digital computer program therefore has been written for the IBM-7094 so that a solution may be obtained. Major emphasis has been placed in the writing of the program so that calculation accuracy and ease of use of the program will result. A comparison of the computer program results with experimental and manual calculations show good correlation. A limited parametric study has been performed and reported herein which shows characteristics to be expected for earth orbit behavior and for an application close to the sun. Author

N68-24004# European Space Technology Center, Noordwijk (Netherlands).
TRENDS IN THE DESIGN OF SATELLITE POWER SUPPLY ELECTRONICS
J. J. Capart Paris ESRO Dec. 1967 49 p refs
(ESRO-TM-111(ESTEC) CFSTI: HC $3.00/MF $0.65

The electronic circuits used for the control and conditioning of power in a satellite play an important role in the overall performances of the power supply. This paper first considers how their characteristics will be affected by future space missions, these assumptions being limited to the power range of interest for European satellites. It then discusses the major design trends and analyzes their effect on the performances. A chapter describes some new power-control and conditioning circuits. The purpose of a development program is finally explained and some practical examples given. Author (ESRO)

N68-24162*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF GULTON 20.0 AMPERE-HOUR STANDARD AND ADHYDRODE NICKEL-CADMIUM SECONDARY SPACECRAFT CELLS
E. C. Bruess 2 Feb. 1968 31 p
(NASA Order W-11252-B)
(NASA-CR-94617; QE/C-68-14) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Standard and anhydrode 20.0 ampere hour nickel-cadmium secondary spacecraft cells were test evaluated for their performance characteristics and limitations including cycle life under various electrical and environmental conditions. Evaluated were leakage, capacity, cell shorts, immersion seal, overcharge, and internal resistance. The capacity and performance of all 54 cells was judged acceptable. G.G.

N68-24189# Siemens-Schuckertwerke A.G., Erlangen (West Germany).
DEVELOPMENT OF A THERMOELECTRIC CONVERTER FOR A NUCLEAR ENERGY SYSTEM [ENTWICKLUNG EINES THERMOELEKTRISCHEN KONVERTERS FUER EIN NUKLEARES ENERGIEVERSORGUNGSSYSTEM]
E. V. Szabo Feb. 1968 69 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBW-68-10) CFSTI: HC $3.00/MF $0.65

During the development of a thermoelectric converter for a nuclear energy supply system recently studies were made of the production of semiconductors by sintering, the electrical conductivity of shoe materials, the compressive strength of complete generators components and the electrical insulation and fixing elements on the hot and cold side. The focal point of the work was the design of a converter featuring an alternatingly stacked ring-tube system for the hot and cold side with modular generator elements and heat transfer by liquid metal in a counter-flow arrangement. Advantages: simple assembly and wiring, uniform pressure on the modules and simple matching to the power requirements by extension of the system. Author

N68-24262 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF CALCULATING TRANSIENTS IN GAS TURBINE POWER PLANTS [METODIKA RASCHETA PEREKHODNYKH REZHIMOV GAZOTURBINNYKH USTANOVOK]

V. V. Selin 14 Sep. 1967 17 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 12, 1963 p 55–64
(FTD-MT-24-155-67; AD-667642)

A method of finite differences for calculating the transient characteristics of a gas-turbine power plant is offered; the method is claimed to be simpler and more reliable as compared to existing methods. The following formulas are developed: rate-of-flow in the turbine; same in the compressor; compression in the compressor; expansion in the turbine; balance of total compression ratio and total expansion ratio; rate-of-change of gas quantity in the capacity (regeneration case); heat exchange in the regenerator; power balance in the compressor shaft; compressor efficiency; turbine efficiency. The above formulas, some additional turbine formulas, and ship-propulsion formulas are tabulated. Peculiarities in the calculation of a load-drop case are discussed. Author (TAB)

N68-24297# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PRESENT STATUS OF CADMIUM SULFIDE THIN FILM SOLAR CELLS
Alan G. Stanley 13 Dec. 1967 40 p refs
(Contract AF 19(628)-5167)
(TN-1967-52; ESD-TR-67-574; AD-667519)

Cadmium sulfide thin film solar cells, especially selected for stability under ambient conditions, experienced severe degradation in their I-V characteristics when subjected to thermal cycling in vacuum. A number of diagnostic techniques were applied to determine the failure mechanism. These included cross-sectioning, infrared measurements, mechanical stress tests and the measurement of series and shunt resistance. Different types of failure modes are discussed. The results of radiation experiments are summarized. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-23057# School of Aerospace Medicine, Brooks AFB, Tex.
THYROID STATUS OF DOGS CONTINUOUSLY EXPOSED TO ONE-HALF ATMOSPHERE, JUNE 1965–JULY 1966
David H. Wood Nov. 1967 21 p refs
(SAM-TR-67-106; AD-666906)

Six male beagle dogs were maintained on ambient air at one-half atmosphere for 33 days and were monitored for protein-bound iodine (PBI), thyroid I 131 avidity, plasma triiodothyronine uptake, and plasma 17-hydroxycorticosteroids. Data were compared with those from Littermate controls held at ground level. Increased I 131 uptake and reduced triiodothyronine uptake were observed in the altitude-exposed dogs, while no change in the peripheral blood hydrocortisone level was seen. No difference in the gross, microscopic, or ultrastructural anatomy of the thyroid glands of groups was noted. Author (TAB)

N68-23080 California Univ., Berkeley.
BIRD VOICES AND RESONANT TUNING IN HELIUM-AIR MIXTURES
George Louis Hersh (Ph.D. Thesis) 1966 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5078

Steller's Jays *(Cyanocitta stelleri)* and Japanese Quail *(Coturnix coturnix)* undergo pronounced voice changes in helium air. These changes are upward translations of relative frequency emphasis. There is no apparent change in the spacing or fundamental frequency of harmonic components. Comparisons were made of normal vocalizations, artificially elicited vocal events and imitation vocal events in which the vibrating membrane sound source was replaced by a probe loud speaker. The observed properties of the vocal tracts of female Mallards *(Anas platyrhynchos)*, Bantam Chickens *(Gallus domesticus)* and Japanese Quail *(Coturnix coturnix)* can be incorporated in a source-filter description of avian vocalization. The birds whose voices remained constant in helium air produced high frequency pure tones. Birds whose voices changed in helium air produced broad spectrum sounds. The effect of the helium is an alteration of the vocal tract filter, and this effect would only be detectable when the sound source produced many simultaneous frequencies. Dissert. Abstr.

N68-23083 California Univ., Los Angeles.
SOLAR RADIATION THROUGH THE BODY WALL OF LIVING VERTEBRATES WITH EMPHASIS ON DESERT REPTILES
Warren Paul Porter (Ph.D. Thesis) 1966 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-4478

A quantitative analysis of the absorption of solar radiation by vertebrate tissues was made using a new, highly sensitive spectrophotometric technique. In vivo light transmission was measured through scales, hair, feathers, skin, muscle and the peritoneim in the spectral region from the ultraviolet through the near infrared (290 mμ to 2600 mμ). Spectral transmission curves are discussed in relation to their adaptive importance and the general physical structues of the tissues comprising the body wall are examined. The presence of the black peritoneum in reptiles is explained. Dissert. Abstr.

N68-23132 Baylor Univ., Waco, Tex.
THE EFFECT OF MICROWAVE EXPOSURE UPON THE AUDITORY THRESHOLD OF HUMANS
Anthony Emile Bourgeois, Jr. (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-2927

The purpose of this experiment was to investigate the effects of exposure to UHF radiation on the auditory thresholds of humans. Thirty-six male volunteers between 18 and 25 years of age and possessing normal hearing were exposed to low intensity radiation at 1,000 Mhz for 2 minutes previous to and during the presentation of the auditory stimuli. Continuous wave (no modulation), 400 cps, and 1,000 cps sine wave amplitude modulated energy were used. The thresholds for 500 cps, 2,000 cps, and 5,000 cps were computed. Analyses revealed that exposure to UHF radiation resulted in a significant decrease in the auditory thresholds and that this decrease was directly proportional to the magnitude of the average power density to which the subjects were exposed. The thresholds were also found to be a function of the type of modulation used since the auditory thresholds were significantly lower upon exposure to the 1,000 cps modulated radiation than upon exposure to 400 cps modulated radiation. Dissert. Abstr.

N68-23160 Purdue Univ., Lafayette, Ind.
RELATION OF POST-EXPOSURE TEMPORARY THRESHOLD SHIFT TO POST-EXPOSURE TEMPORARY LOUDNESS SHIFT
Donald Frank McPherson (Ph.D. Thesis) 1966 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-5462

Investigations which have been concerned with changes in the sensitivity of the ear as a result of prior or concurrent exposure to sound can be grouped into two broad categories on the basis of the sensitivity index employed in the investigation. These categories would be: (1) investigations in which the sensitivity index is the temporary threshold shift (TTS) measured following

exposure of the ear, and (2) investigations in which the sensitivity index is the temporary loudness shift (TLS) in a comparison signal presented to the contralateral ear either during or following exposure of the ipsilateral ear. This investigation was designed to explore the relationships between post-exposure TTS and post-exposure TLS when both measures were obtained under similar experimental conditions. A special paradigm was designed which could be adapted to measure either TTS or TLS. Three different measures of sensitivity (TTS, TLS with loudness balances made at the exposure level, and TLS with loudness balances made at a constant 30 dB SPL) were obtained on one ear of each of five normal-hearing trained observers. Dissert. Abstr.

N68-23171# Armed Forces Radiobiology Research Inst., Bethesda, Md.

MONKEY PERFORMANCE TESTING APPARATUS (MAZE)

S. J. Kaplan and H. D. Cooper Nov. 1967 25 p refs

(AFRRI-TN67-1; AD-666643)

A description is presented of a special performance testing device, the Kaplan-AFRRI Maze (KAM), designed for studying radiation effects upon the monkey. The structure and functions of this automated maze are provided. The material covered in this report also includes the environmental chamber for the KAM, manual and automatic operation, programming for automatic control, the data acquisition system and the data processing procedures. Author (TAB)

N68-23180*# McMaster Univ., Hamilton (Ontario). Dept. of Psychology.

ATTENTION-LIKE PROCESSES IN CLASSICAL CONDITIONING

Leon J. Kamin 1 Jun. 1967 32 p refs Presented at the Symp. on Aversive Motivation, Miami, Apr. 1967

(Grant NGR-52-059-001)

(NASA-CR-94532; TR-5) CFSTI: HC $3.00/MF $0.65 CSCL 05J

Naive hooded rats, reduced to 75% body weight and maintained on a 24-hr feeding rhythm, were used in conditioned emotional response (CER) studies. The rats were trained to press a bar for food reward during 2-hr daily sessions, and food pellets were delivered according to a 2.5-min variable interval reinforcement schedule. After five 2-hr sessions, stable bar-pressing rates were produced in individual rats and CER training was started. The same food schedule was in effect during CER training; but four noise, light, or combined CS-US (conditioned stimulus-unconditioned stimulus) sequences were programmed independently of the animal's behavior. After a very few trials of such training, all rats approached asymptotic suppression. M.W.R.

N68-23187# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

MATHEMATICAL MODELS FOR THE ANALYSIS OF THE NITROGEN WASHOUT CURVE, JULY 1963-JANUARY 1967

Robert G. Rossing, M. Bryan Danford, Earl L. Bell, and Raul Garcia Nov. 1967 63 p refs Submitted for publication

(SAM-TR-67-100; AD-666651)

A general mathematical description of the washout of nitrogen from the lung during oxygen breathing is developed. From this, several specific mathematical models are derived and compared. These models each involve one of three different variables for description of the washout process: the alveolar dilution ratio, the specific tidal volume, or the rate constant. Two different types of models are considered: one involves a discrete distribution function of the basic variable; the other, a continuous distribution function. Several such models are applied to a series of washout curves as test problems. They are all found to be capable of fitting such curves with approximately equal precision. The choice between them must, therefore, be based on other factors such as theoretical suitability and ease of interpretation. On the basis of these criteria, the model suggested is one in which the alveolar dilution ratio manifests a Normal distribution, either unimodal or bimodal. Methods are developed for the calculation of certain indices from the parameters of this model. These indices may be of value in evaluating intersubject comparisons as well as intrasubject comparisons over time. Finally it is shown that these same indices may be calculated directly from the raw data, independent of any postulated distribution model. Author (TAB)

N68-23193*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.

SELF-ASSEMBLY OF THE PROTOCELL FROM A SELF-ORDERED POLYMER

Sidney W. Fox [1967] 28 p refs Presented at Intern. Conv. of Biochem., Bangalore, India, 7 Sep. 1967

(Grant NsG-689)

(NASA-CR-94534) CFSTI: HC $3.00/MF $0.65 CSCL 06C

It is reported that when amino acids are simply and suitably heated, polypeptide sequences form by themselves to at least some degree and in the "right amounts." The organization of the polypeptides is shown to take care of itself when water is added to thermal protenoid, which appears to be the right component to crystallize out as a cell. While individual properties of proteins, polynucleotides, and cells can be mimicked by other substances; thermal proteinoid and its organized particles are the only synthetic products that have been shown to possess the properties of the contemporary cell and its structural polymer. Buds are shown in a number of protenoid microspheres that were allowed to stand for two weeks; and this permits the visualization of how such microspheres could have developed the ability to participate cyclically in their own reproduction. Experiments indicated that multiplication could occur through the model of primitive kind of binary fission and growth by accretion as well as through budding. M.W.R.

N68-23199# Oak Ridge National Lab., Tenn.

ON THE RELATIONSHIP OF COLLISION THEORY TO THE INTERPRETATION OF RELATIVE BIOLOGICAL EFFECTIVENESS

J. E. Turner and Hal Hollister Jan. 1968 11 p refs

(Contract W-7405-ENG-26)

(ORNL-4215) CFSTI: HC $3.00/MF $0.65

Relative biological effectiveness (RBE) is observed to depend upon the physical characteristics of radiation and on the biological effect or end point being studied. The quantity most often used to describe the quality of radiation is its linear energy transfer (LET), or, in the case of uncharged radiation, the LET of charged secondary particles. The quantum mechanical collision theory was applied to see which physical quantities are relevant in the sense that RBE depends on them, biological factors being kept fixed. By means of successive Born approximations it is shown that the velocity and charge of a heavy charged particle are ultimately the only physical quantities that are needed to describe RBE in terms of the properties of the incident radiation, and these two quantities enter the description of RBE in a combination other than that of the LET function. An experimental test of the practical significance of these results is suggested. Author (NSA)

N68-23244# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

INVESTIGATION OF THE PRIMATE VESTIBULAR SYSTEM FUNCTION THROUGH ANALYSIS OF THE VESTIBULO-OCULAR REFLEX RESPONSE TO VARIOUS INPUT STIMULI

Marvin H. Chasen (M.S. Thesis) and James W. Guthrie (M.S. Thesis) Dec. 1967 116 p refs

(GE/EE/675-7; AD-666663)

An indirect measurement of dynamic responses of the primate vestibular system was obtained through the measurement of eyeball counterroll from six Rhesus monkeys. A control system was developed to provide three types of input stimuli. These stimuli

consisted of constant speed rotations, pendular oscillations, and Gaussian random noise. The experimental data was analyzed by use of correlation functions, power spectral density functions, and probability densities. Results show that angular acceleration and the acceleration resulting from centripetal force affect the counterroll response. Gaussian noise position inputs failed to produce counterroll distributions that are Gaussian. Suppression of response to random inputs was observed, indicating that suppression does not necessarily result from anticipation of the input. Author (TAB)

N68-23251 New School for Social Research, New York.
VISUAL BEAT PHENOMENA AND THEIR RELATION TO THE TEMPORAL CHARACTERISTICS OF PERCEPTION
Rathe S. Karrer (Ph.D. Thesis) 1966 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4113

This series of studies utilized the phenomena of visual beats, produced by the combination of intermittent light pulses, to investigate the temporal characteristics of visual perception. Visual beats, seen both in binocular and dichoptic vision, are characterized by apparent movement, a change in brightness and flicker rate, and a change in the figural and color phenomena which are sometimes elicited by flicker alone. Data for both photopic and scotopic vision indicated that the visual system follows the stimulus frequency accurately all the way to CFF; above this frequency no beats were perceived. All the evidence from this work leads to the conclusion that the visual system can adapt to the temporal conditions of stimulation to an extent not previously indicated by two-pulse and short-train studies. The visual beat technique indicates that temporal resolution varies over wide limits depending on the conditions of perception. Dissert. Abstr.

N68-23276# School of Aerospace Medicine, Brooks AFB, Tex.
AUTOMATED DETERMINATION OF GLUCOSE USING GLUCOSE OXIDASE AND POTASSIUM FERROCYANIDE Final Report, 1 May–30 Sep. 1967
James W. Hall and Donald M. Tucker Jan. 1968 11 p refs Submitted for publication
(SAM-TR-68-4; AD-666925)

A study was undertaken to find a rapid, accurate, and reproducible method for determining blood glucose. For these reasons, the decision was made to adapt the glucose-oxidase procedure for use on an automatic system. It was subsequently found, however, that existing technics did not meet all the criteria specified. The procedure was modified so that the problem of carry-over (encountered when o-tolidine or o-dianisidine is used) was eliminated. Author (TAB)

N68-23292# Rome Univ. (Italy).
KINETICS STUDIES ON HEMOPROTEINS BY FLASH PHOTOLYSIS Final Scientific Report, 31 Jan. 1967–31 Jan. 1968
Eralso Antonini 31 Jan. 1968 7 p refs
(Grant AF-EOAR-62-82)
(AFOSR-68-0524; AD-666691)

Results in the following areas of investigation are summarized: kinetic effects of the reversible dissociation of hemoglobin into side chain molecules; reaction of isolated alpha-CO and beta-CO hemoglobin chain to form hemoglobin (alpha-2 beta-2) (CO)4; kinetic behavior on flash photolysis of the high molecular weight hemoglobin from the earthworm; spectral difference between the deoxygenated hemoglobin chains and hemoglobin. TAB

N68-23296# School of Aerospace Medicine, Brooks AFB, Tex.
PHYSIOLOGIC AND BIOCHEMICAL OBSERVATIONS ON THE RHESUS MACACA MULATTA EXPOSED TO OXYGEN-RICH ATMOSPHERES
Frode Ulvedal and H. E. Brown Sep. 1967 27 p refs
(SAM-TR-67-86; AD-666923)

Adolescent male rhesus monkeys (Macaca mulatta), weighing 2.9 to 3.4 kg., were exposed to 100% oxygen atmospheres at 258 and 380 mm. Hg pressures for 30 and 22 days, respectively, and the results obtained were compared to the observations made in a ground-level control study using the same chamber system. Physiologic, hematologic, enzymatic, biochemical, and anatomic measurements were obtained throughout the experiments. Several changes and trends were common to all three experiments; however, some were observed only for the oxygen-exposed animals and were dependent on the concentration of oxygen in the atmosphere. Author (TAB)

N68-23343# School of Aerospace Medicine, Brooks AFB, Tex.
BITE-SIZE FOOD IN FIGHTER AIRCRAFT Final Report, Aug. 1966–May 1967
May J. O'Hara and John E. Vanderveen Dec. 1967 15 p refs Submitted for publication
(SAM-TR-67-114; AD-666909)

Bite-size foods were consumed by pilots of fighter-type aircraft in two trials, and data were collected on the acceptability and ease of handling these foods. This type of feeding system offers foods that are stable without refrigeration, are easy to handle, and need no kitchen facility for preparation. Bite-size food flavors at the present time do not surpass those of conventional foods. Author (TAB)

N68-23396*# Emory Univ., Atlanta, Ga.
[RADIATION MEASUREMENT OF RADIOBIOLOGICAL HAZARDS OF MAN IN SPACE] Semiannual Report, 1 Oct. 1967–31 Mar. 1968
Norman A. Baily 31 Mar. 1968 55 p refs
(Grant NGR-11-001-026)
(NASA-CR-94575) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Isodose patterns, cyclotron experiments on parasitic organisms, microdosimetric distributions, and energy event frequency distributions were studied in relation to radiobiological hazards to men exposed to space environments. Equipment for the cyclotron work was acquired and constructed, and tissue-equivalent absorbers were constructed for use with the tissue-equivalent proportional counter so that microdose distributions at various tissue depths could be studied. Measurement and characteristics of depth dose patterns due to proton beams were studied; and the absorbed dose by animals or humans subjected to irradiation was found to be dependent upon the organ or region under consideration, beam geometry, material through which the beam passes prior to incidence on the subject, and other factors peculiar to the particular case under investigation. A computer program was designed to use experimental depth dose data to produce isodose curves, which were computed for proton energies between 45.8 and 730 MeV. M.W.R.

N68-23407# Florida State Univ., Tallahassee. Dept. of Biological Science.
RESEARCH IN PHOTOBIOLOGY AND PHOTOCHEMISTRY Final Report, 1 May 1965–30 Apr. 1967
H. Gaffron 1 Feb. 1968 6 p refs
(Grant AF-AFOSR-662-65)
(AFOSR-68-0493; AD-666912)

A summary is given of investigations of the manganese content of chloroplasts, activation of photosynthesis by manganese, two types of damage in higher plants due to manganese deficiency, and the distribution of manganese in structurally different chloroplasts in relation to particular metabolic activities displayed by such chloroplasts. Another investigation dealt with the response of photosynthesis and respiration to desiccation in the fern Polypodium polypodioides. Author (TAB)

N68-23416# Communication Research Inst., Miami, Fla.
REPROGRAMMING OF THE SONIC OUTPUT OF THE DOLPHIN: SONIC BURST-COUNT MATCHING Annual Report (Final), 1 Nov. 1966–31 Oct. 1967
John C. Lilly, Alice M. Miller, and Henry M. Truby 21 Oct. 1967 47 p refs
(Grant AF-AFOSR-415-67)
(CRI-0267; AFOSR-68-0518; AD-666690)

The sound producing mechanisms in the bottlenose dolphin (Tursiops truncatus) operate naturally underwater with a closed blowhole. In these experiments Tt's reprogrammability in the vocal airborne mode and in vocal-ascoustic interlock with another species is demonstrated. Human speech output programs were constructed from randomized vowel-consonant (V-C) and consonant-vowel (C-V) lists and simple English words and phrases. The analysis of the dolphins sonic vocal output in response to these Hs vocal programs demonstrates Tt's reprogramming: in matching number of trains of bursts, interburst silences, and latencies; ability to differentiate between Hs stimuli and other Hs comments or corrections, and ability to program from natural delphinic sounds to humanoid emissions. Author (TAB)

N68-23446*# Scripta Technica, Inc., Washington, D. C.
HORIZONTAL AND AMACRINE CELLS OF THE RETINA: PROPERTIES AND MECHANISMS OF THEIR CONTROL OVER THE BIPOLAR AND GANGLIONIC CELLS [CELULAS HORIZONTALES Y AMACRINAS DE LA RETINA: PROPIEDADES Y MECHANISMOS DE CONTROL SOBRE LAS BIPOLARES Y GANGLIONARES]
G. Svaetichin Washington NASA May 1968 21 p refs Transl. into ENGLISH from Acta Cient. Venezolana (Spain), Suppl. 3, 1967 p 254–276
(Contract NASw-1694)
(NASA-TT-F-11582) CFSTI: HC $3.00/MF $0.65 CSCL 06P

A general review is presented of the morphological and electrophysiological findings which support our theory concerning the horizontal and amacrine cell control of the excitability and coding mechanisms of the retina. Evidence is presented for (1) the existence of a functional contact between horizontal cells and amacrine cells, which is different from the electrical or chemical synapse; and (2) the nonionic nature of the S-potentials, which are intimately dependent on plasma membrane respiration. Various proofs are given for the fact that horizontal cells exert their nonspecific excitability control on the bipolar cell dendrites through a transferaptic influence. By analogy, certain amacrine cells exert a specific control, wavelength- or space-dependent, on the dendrites of certain ganglion cells coding color, black-white or space. Author

N68-23455*# Southwest Research Inst., Birmingham, Ala.
SOUTHWEST RESEARCH INSTITUTE ASSISTANCE TO NASA IN BIOMEDICAL AREAS OF THE TECHNOLOGY UTILIZATION PROGRAM Cumulative Quarterly Report, 1 Oct. 1967–31 Mar. 1968
Ray W. Ware and Louis S. Berger 15 Apr. 1968 67 p
(Contract NASw-1714; SwRI Proj. 14-2329)
(NASA-CR-94586) CFSTI: HC $3.00/MF $0.65 CSCL 06E

The operations of the research institute during the reporting period are summarized. Listed are the biomedical problems and cases that were processed, current and projected activities, program participants, operating personnel, and documents supplied to participants. The information transfer process is briefly discussed. K.W.

N68-23533*# Arkansas Univ., Little Rock.
RADIATION-INDUCED NUCLEIC ACID SYNTHESIS IN L CELLS UNDER ENERGY DEPRIVATION
J. L. Sanders, Glenn V. Dalrymple, Max L. Baker, K. P. Wilkinson, and Paul A. Dixon Dec. 1967 31 p refs
(Grant NGR-04-001-014)
(NASA-CR-73220) CFSTI: HC $3.00/MF $0.65 CSCL 06R

The L cells show a brief, accelerated uptake of radioactive precursor into both DNA and RNA following relatively low doses of radiation. This response appeared for cells being starved in a glucose-free salt solution and for cells treated with 2,4-dinitrophenol. Three distinct features characterize the response. First, a relatively fixed postirradiation time delay seems necessary before the accelerated labeling of the nucleic acids occurs. Second, the labeling of the DNA fraction closely parallels the labeling of the RNA fraction. Finally, the radioactive label appears to enter and then to leave both nucleic acid fractions. Although the accelerated labeling was most apparent after 100 rads, it also happened at higher doses where several cycles of incorporation and loss of label appeared. Since comparable changes were not found under normal growth conditions, this response presumably results because of the energy-deprived state. Both continuous labeling and pulse methods were used; the nucleic acids were labeled with either inorganic phosphate–P32 or radioactive precursors specific for a given fraction. Survival studies indicated that cells treated with 2,4-dinitrophenol had an increased resistance to X-rays. Author

N68-23581# Stanford Univ., Calif. Instrumentation Research Lab.
MOLECULAR BIOLOGY APPLICATIONS OF MASS SPECTROMETRY Final Report, 1 Jul. 1965–31 Dec. 1967
Joshua Lederberg and Elliott C. Levinthal 31 Dec. 1967 53 p refs
(Contract AF 49(638)-1599)
(IRL-1073; AFOSR-68-0529; AD-666667)

Summaries are given of research efforts in the following areas: Volatilization of molecules of biological interest; spectral analysis of monomers; computer control of mass spectrometers; data retrieval and display; computer manipulation of chemical hypotheses. References to papers previously published in professional journals and technical reports are included. TAB

N68-23619# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
EFFECTS OF SLEEP DEPRIVATION ON THE VESTIBULO-OCULAR REFLEX Progress Report
James W. Wolfe and James H. Brown 13 Feb. 1968 16 p refs
(USAMRL-766; AD-666750)

Sixteen young adult men were deprived of sleep for a period of 24 hours in an attempt to assess possible interactions between sleep mechanisms and the vestibular system. Ss were given a pre- and post-test consisting of trials at angular accelerations of 8 degrees/sec sq and 24 degrees/sec sq. Following sleep deprivation, Ss showed a significant increase in fast-phase frequency at 24 degrees/sec sq, and a nonsignificant increment at 8 degrees/sec sq. Slow-phase output reflected a significant decrement at 8 degrees/sec sq, but no significant decrement at 24 degrees/sec sq. Subjective latency estimates of stimulus onset showed no significant changes for either 8 degrees or 24 degrees/sec sq. Discussion centers around possible physiological mechanisms related to sleep and vestibular responses. Author (TAB)

N68-23715# Army Medical Research Lab., Fort Knox, Ky.
EFFECT OF D-TUBOCURARINE ON THE SCALING OF EFFORT OF ISOMETRIC MUSCLE CONTRACTIONS Progress Report
Richard P. Smith (Louisville Univ.), Lee S. Caldwell, and Donald M. Thomas (Louisville Univ.) 7 Feb. 1968 9 p refs
(USAMRL-765; AD-666749)

The purpose of this study was to determine whether the alteration in voluntary strength produced by d-tubocurarine, and the consequent reduction in feedback from the muscles, would distort a subjects normal reference for judging the effortfulness of a task, and change the slope of the effort function. The effort function obtained with d-tubocurarine was not significantly different from those secured in the normal and placebo conditions. Thus, it was concluded that the motor units remaining functional after the administration of d-tubocurarine fatigue normally, and that the slope of the effort function is determined by the relative rather than the absolute number of motor units required to maintain the contraction. Author (TAB)

N68-23716*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.

THE BIOCHEMICAL, PHYSIOLOGICAL, AND METABOLIC EFFECTS OF APOLLO NOMINAL MISSION AND CONTINGENCY DIETS ON HUMAN SUBJECTS WHILE ON A SIMULATED APOLLO MISSION Final Report, Feb.–Jun. 1966

Bernard J. Katchman, James P. F. Murphy, Vickie R. Must, and Ellis Patrick Wright-Patterson AFB, Ohio AMRL Dec. 1967 122 p refs Sponsored jointly by NASA and USAF

(Contract AF 33(657)-11716)

(NASA-CR-94588; AMRL-TR-67-164) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Four human male subjects participated in a 90-day experiment which consisted of 60-day and 30-day periods of confinement with a 5-day break between the confinement periods. The subjects were confined with pressure suits worn unpressurized and pressurized at 3.7 psi. The subjects ate a fresh food diet, an Apollo nominal mission diet, or an Apollo contingency diet; the diets provided 2200, 2500, and 900 kcal/day, respectively. The subjects lost about 500 g/day of body weight while on the contingency diet of which about 50% is estimated to be water. About 40 g/day of body weight was lost because of protein catabolism. Blood levels of sodium, potassium, phosphorus, chloride, calcium, and magnesium were maintained in the normal range of clinical values. Oral body temperature, pulse rate, respirations, blood pressure, and basal metabolic rate all were in the normal range of clinical values. However, the 17-hydroxycorticoids of the urine decreased to low normal and lower than normal ranges of clinical values. Three of the four subjects were able to complete a simulated Apollo emergency mission while in a pressure suit pressurized at 3.7 psi and on a 900-calorie contingency diet. Author

N68-23729*# Techtran Corp., Glen Burnie, Md.

OVERRIPENESS OF THE EGGS AS CAUSAL FACTOR IN THE APPEARANCE OF MULTIPLE FORMATIONS AND TERATISMS [UBERREIFE DER EIER ALS KAUSALER FAKTOR BEI DER ENTSTEHUNG VON MEHRFACHBILDUNGEN UND TERATOMEN]

Emil Witschi Washington NASA May 1968 9 p refs Transl. into ENGLISH from Verhandl. Naturforsch. Ges. Basel, v. 34, 1922–1923 p 33–40

(Contract NASw-1695)

(NASA-TT-F-11684) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Both heat and overripeness of eggs are seen to be a factor in producing multiple formations and teratisms in frogs. Radical malformations were observed to result from either factor. Limiting himself to a description of observations of the living object, the author investigates the causal genesis of these phenomena. The following two causes are specifically named: loosening of intercellular bonds and varying degree of damage of different parts of the egg resulting from overripeness. Author

N68-23801# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.

THE POINT SOURCE METHOD OF DOSE CALCULATION IN MEDIA OF VARYING DENSITY WITH SPECIAL REFERENCE TO β-PARTICLES

W. J. Whitehouse Jan. 1968 22 p refs

(AERE-R-5679) CFSTI: HC $3.00/MF $0.65

The point source method is adapted to calculating the energy deposition in media of varying density and discussed, with special reference to the dose from β-particles in trabecular bone. The dose reciprocity theorem is restated in a form consistent with the density-dependent point source formula. The Loevinger point source formula for β-rays is used to solve two models: (1) alternating infinite slabs of different substances; and (2) a hollow sphere filled with one substance and surrounded by another. The numerical values used in these solutions correspond to the bone-seeking nuclides ^{90}Sr, ^{90}Y, and ^{32}P, and to substances with the density and mean composition of trabecular bone. The solutions indicate that the mean dose in trabecular bone is not markedly different from that which would be calculated on the assumption that the bone and marrow were intimately mixed. Author

N68-23914# Naval Radiological Defense Lab., San Francisco, Calif.

EFFECTS OF TOTAL-BODY IRRADIATION ON THE IMMUNE ELIMINATION OF I^{131} HORSE SERUM ALBUMIN IN LAF_1 MICE

Walter W. H. Weyzen, Gerald M. Vattuone, and Myron S. Silverman 8 Feb. 1968 55 p refs

(USNRDL-TR-68-22; AD-667231)

The effect of total-body irradiation on the primary antibody response to horse serum albumin in mice was studied. Mice were irradiated with doses ranging from 100 to 400 R and were immunized 24 hours later. At various time intervals thereafter, the antibody response was determined by measuring the elimination of a tracer dose of I131 horse serum albumin from the plasma. From the results of these measurements, the induction period, the slope of the elimination curve and the T99 was calculated. The immune response was expressed in terms of T99, i.e., the time (hours) required for the elimination of 99% of a given amount of antigen from the plasma. The radiation effects observed consisted in a delay of the onset of immune elimination and a decrease in the rate of appearance of anti-bodies in the plasma. The relationship between T99 and the time of injection of the tracer dose (days after immunization) in mice irradiated with doses up to 300 R was similar to that observed in non-irradiated immunized mice. However, the initial period during which T99 remained constant was lengthened in mice exposed to 200 and 300 R. In addition, the subsequent linear decrease of T99 with time occurred at a lower rate. The relative immune response, based on the T99 observed when the tracer dose was injected 7 days after immunization, provided a basis for comparison of the radiation injury to the immune system at the various dose levels. When the relative immune response was plotted against the radiation dose, a linear dose-effect curve was obtained. The radiation dose required to obtain a 50% depression of the immune response was found to be 175 R. Author (TAB)

N68-23933# Syracuse Univ., N. Y.

DETECTION AND IDENTIFICATION OF MICROORGANISMS BY GAS CHROMATOGRAPHY

J. R. Gould *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 39 p refs Presented at Dept. of AF, Office of Aerospace Res., Res. Appl. Conf., Washington, D. C., Mar. 1968 Supported in part by AF (See N68-23931 13-34)

Based on the principle that differences among strains of free living microorganisms would be reflected in the products released during metabolism, a study, using gas liquid chromatography

in conjunction with ultrasensitive detectors, was initiated to assess the feasibility of characterizing the organisms by the distinctions in their metabolic products. The method consists of the inoculation of a nutrient solution, incubating for the period necessary for the formation of products in detectable quantities, and extracting the metabolic products for chromatographic analysis. A signature, based on the chromatogram, is assigned to the particular organism under investigation. Since the signature expresses the presence or absence of components (peaks), the presence of unique molecules, and an ordered arrangement of the quantity of each component, it conveniently differentiates (fingerprints) the strains. It has been demonstrated that bacteria and viruses may be identified by a chromatographic analysis of their metabolites. *Bacillus licheniformis* and *B. subtilis* were identified using as little as 6×10^{-6} ml of medium, and required only 2×10^{-8} ml of medium to be reproducibly detected. Viruses were identified by the reaction products of the host cell response to viral infection using tissue cultures. Also, viral infection in animals was detected up to 8 days prior to the appearance of clinical symptoms. S.C.W.

N68-24091# Fraunhofer-Gesellschaft Zur Forderung der Angewandten Forschung e. V., Grafschaft (West Germany). Institut fuer Aerobiologie.

SURVIVAL CHANGES OF MICROORGANISMS UNDER THE ENVIRONMENTAL CONDITIONS OF IONOSPHERE AND STRATOSPHERE [UEBERLEBENSCHANCEN VON MIKROORGANISMEN IM MILIEU VON IONOSPHAERE UND STRATOSPHAERE]

E. Petras and K. Bisa Jan. 1968 49 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung (BMWF-FBW-68-09) CFSTI: HC $3.00/MF $0.65

Rocket, Balloon, and laboratory experiments confirmed the assumption that within the ionosphere and stratosphere, microorganisms are endangered primarily by UV and EUV radiations. Harmful effects caused by other factors have not been detected. Spores of Bac. globigii damaged by exposure to direct solar irradiations within the stratosphere or near the earth surface could be photo-reactivated to a relevant degree. It appears that the radiation dosage of EUV must be larger than the corresponding dosage of UV in order to prevent spore reproduction, but EUV-affected cells have little or no chance to become photo-reactivated. Author

N68-24127# Stanford Research Inst., Menlo Park, Calif.

INVESTIGATIONS OF LASER DAMAGE TO OCULAR TISSUES Interim Report, 5 Apr.–31 Aug. 1967

A. Vassiliadis, N. Peppers, K. Dedrick, H. Chang, R. C. Honey et al Sep. 1967 40 p refs

(Contract F33615-67-C-1752)

(AD-667555)

Preliminary results of experimental investigations of minimally sized retinal lesions caused by neodymium lasers are presented. The experimental animals were rhesus monkeys. Data for both long-pulse neodymium and Q-switched neodymium lasers are included. Results of experimental investigation for threshold damage by a CW CO2 laser to rabbit corneas are also presented. Data for two exposure times are included. In addition, theoretical calculations based on a one-dimensional heat-flow model are reported, and comparison is made with the experimental results. Author (TAB)

N68-24218# Naval Radiological Defense Lab., San Francisco, Calif.

URINARY PYRIMIDINES AFTER X RADIATION

Charles D. Guri and Leonard J. Cole 6 Feb. 1968 18 p refs

(USNRDL-TR-68-15; AD-667237)

Urinary deoxycytidine and other pyrimidines were studied in rats after whole-body irradiation. Utilizing combined column and paper chromatography and colorimetric determination of the isolated CdR, significant elevations in the excretion of this compound were observed during the first 24 hours after rradiation. An increase in the plasma concentrations of CdR was also observed within 4 hours after X irradiation (100 R). Utilizing both anion and cation exchange chromatography X radiation has been shown to produce an increase in several other pyrimidines, including derivatives of the bases cytosine, thymine and uracil. While these data were suggestive of a radiation induced generalized pyrimidinuria, the urinary deoxycytidine and thymidine demonstrated remarkable elevation and were predominantly responsible for this phenomenon. Author (TAB)

N68-24256# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

FORMAL ANALYSIS OF PROTEIN SEQUENCES. 2. METHOD FOR STRUCTURAL STUDIES OF HOMOLOGOUS PROTEINS AMINO ACID SUBSTITUTIONS IN CYTOCHROMES C

A. Krzywicki and P. P. Slonimski (Centre de Genetique Mol. du C.N.R.S.) Mar. 1968 39 p refs

(TH/68/18) CFSTI: $3.00

A method of formal analysis of homologous protein sequences is developed. Structural aspects of the problem are emphasized and not the phylogenetic ones. A special mathematical treatment of the redundancy of comparisons within a set of homologous sequences is given. This treatment obtains statistically significant results with the actually available experimental information. The method is applied to the study of tandem aminoacid substitutions in mitochondrial cytochromes c. It is shown that adjacent substitutions are significantly more frequent than expected assuming that substitutions are mutually independent. This latter independence is roughly verified for more distant substitutions. A tentative genetic mechanism that could lead to such an effect is proposed. Author

N68-24272*# Scientific Translation Service, La Canada, Calif.

THE ORIGIN AND INITIAL DEVELOPMENT OF LIFE

A. I. Oparin Washington NASA May 1968 60 p refs Transl. into ENGLISH of the book "Vozniknoveniye i Nachal'noye Razvitiye Zhizni" Moscow, Meditsina, 1966

(Contract NASw-1496)

(NASA-TT-F-488) CFSTI: HC $3.00/MF $0.65 CSCL 06B

A book is presented on the history of the development of life on earth. A brief review of the attempts to solve the origin of life is given along with an objective chronology of the events leading to the origin and initial development of life. The initial stages in the development of carbon compounds is described, and the formation of the primary broth is examined. Details are given on the rise of prebiological systems, and the evolution and rise of primitive organisms with the subsequent evolution of primary organisms is described. B.S.D.

N68-24293*# McMaster Univ., Hamilton (Ontario). Dept. of Psychology.

PREDICTABILITY, SURPRISE, ATTENTION, AND CONDITIONING

Leon J. Kamin Dec. 1967 31 p refs Presented at the Symp. on Punishment, Princeton, N. J., May 1967

(Grant NGR-52-059-001)

(NASA-CR-94558; TR-13) CFSTI: HC $3.00/MF $0.65 CSCL 05J

The possible role of attention in Pavlovian conditioning is discussed, and the kinds of experimental manipulations which might direct an animal's attention to one of another element are considered. Basic conditioning procedures used in experiments on rats are described. Median suppression ratios are given, as a function of acquisition trial, for three representative groups of subjects which were conditioned with either white noise, light, or a compound of noise and light presented simultaneously. It was

noted that after a few trials all groups approach asymptotic suppression. In other experiments, the results indicate: (1) Granted prior conditioning to an element, no conditioning occurs to a new element which is superimposed on the old. (2) If the superimposed element provides new information, the animal not only notices the element but can utilize the information which it provides with impressive efficiency. (3) At least on the first transitional trial, an animal previously conditioned to a single element notices the superimposition of a new element. M.G.J.

N68-24330*# National Aeronautics and Space Administration, Washington, D. C.

ON METHODS FOR THE DETERMINATION OF THE RESPIRATORY QUOTIENT DURING REST AND WORK [ZUR METHODIK DER RESPIRATORISCHEN QUOTIENT BESTIMMUNGEN IN RUHE UND BEI ARBEIT]

E. H. Christensen and O. Hansen Feb. 1968 40 p refs Transl. into ENGLISH from Skand. Arch. fur Physiol. (Leipzig), v. 81, 1939 p 137–179

(NASA-TT-F-11466) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Reliable determinations of the respiratory gas exchange in man may be of greatest significance in the laboratory and in the clinic. With untrained subjects one usually has to be content with the determination of the O_2-uptake since the CO_2-output, as measured in metabolic studies, frequently is a poor expression for the simultaneous CO_2-production so that a reliable interpretation of the experimental results is not possible. However, also the results of experiments with trained subjects may be afflicted with considerable errors in the case of poorly controlled experimental conditions. In the following we have attempted to demonstrate several of these sources of error with specific consideration of determinations during work and to discuss them. Author

N68-24340*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.

CAN MAN START AN EVOLUTION?

Sidney W. Fox [1967] 31 p refs Presented at Le Conte du Nuoy Mem. Symp., Notre Dame, Ind., 28 Oct. 1967 *Its* Contrib. No. 097

(Grant NsG-689)

NASA-CR-94557) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Primoridal formation of protein and nucleic acid are regarded as origin of life with eventual evolution from primitive cell to contemporary cell and to contemporary multicellular organisms. Spontaneous organic synthesis involved in the production of organic molecules was experimentally investigated by analyses of polypeptide sequences. It is shown that when amino acids are carefully heated, polypeptide sequences to at least some degree take place. The addition of water seems to be the right component to crystallize out as a cell. G.G.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-23185 Tufts Univ., Medford, Mass. Inst. for Psychological Research.

HUMAN FACTORS ENGINEERING BIBLIOGRAPHIC SUPPLEMENT NUMBER 1: A BIBLIOGRAPHY ON THE USE OF INFORMATION THEORY IN PSYCHOLOGY (1948–1966)

E. M. Johnson Dec. 1967 80 p refs *Its* HEL Bibliographic Suppl. no. 1

(Contract DA-18-001-AMC-1004(X))

(AD-664773)

The bibliography contains 756 citations of work that have been done relevant to psychology in information theory. Information theory is distinguished from the broader disciplines of communication theory and cybernetics by the use of a particular measure of amount of information. Author (TAB)

N68-23239# Bucknell Univ., Lewisburg, Pa.

EFFECT OF AROUSED TESTING CONDITIONS ON THE MEASUREMENT OF FEAR OF FAILURE

Richard C. Teevan and Richard A. Dapra 1968 21 p refs

(Contract Nonr-3951(01))

(TR-25; AD-666963)

The Thematic Apperception Test (TAT) was administered to 38, male, high school Ss under both neutral and aroused conditions. The TATs were scored for fear of failure (FF) motivation as measured by the Hostile Press (HP) system developed by Birney, Burdick, and Teevan (1964). An exploratory investigation was conducted to determine the effect of aroused and neutral testing conditions on the amount of HP imagery and its intensity within the same group of Ss. The results indicated that HP scores increased significantly between the neutral and aroused conditions. Nevertheless, a dichotomy of the HP scores at the median indicated that the scores of Ss categorized Low HP under the neutral condition increased significantly under the aroused condition. HP scores of Ss categorized Hi HP under the neutral condition had significantly lower HP scores under the aroused condition. The results were discussed in terms of the FF Ss interpretation of the situation and his defensive posture. Author (TAB)

N68-23255*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MEASUREMENT OF PILOT DESCRIBING FUNCTIONS FROM FLIGHT TEST DATA WITH AN EXAMPLE FROM GEMINI 10

Rodney C. Wingrove and Frederick G. Edwards [1967] 16 p refs Presented at the 4th Ann. Conf. on Manual Control Systems, Ann Arbor, Mich., 21–23 Mar. 1968

(NASA-TM-X-61071) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Under normal flight test conditions, it has been known that there is an error in measuring the pilot describing function due to a correlation of the input error signal with the pilot's output noise. It is shown in this paper that this measurement error can be reduced by shifting the input signal during the computer processing by an amount equivalent to the pilot's time delay. This technique is based on a theoretical development which considers the fact that the measurement is constrained to identify only physically realizable systems. The simulation and identification of an example pilot mode is presented. Data from the retrofire phase of the Gemini X flight are used to demonstrate the feasibility of this technique with normal spacecraft operating records. Author

N68-23317*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

EXPERIMENTS ON AIM POINT ESTIMATION AT VARIOUS RATES OF CLOSURE

Everett A. Palmer 23 Mar. 1968 10 p refs Presented at 4th Ann. Conf. on Manual Control Systems, Ann Arbor, Mich., 21–23 Mar. 1968

(NASA-TM-X-61077) CFSTI: HC $3.00/MF $0.65 CSCL 05H

As an aircraft approaches the earth all points on the ground appear to the pilot to expand radially out from a stationary point on the ground toward which the aircraft is aiming. If the pilot can detect this point of zero expansion, he knows precisely the point on the ground toward which his aircraft is aiming. Experimental

evidence is presented as to how precisely a pilot can actually detect this aim point. Since any point in the pilot's field of view always moves radially out from the aim point, it is necessary to know only the magnitude of the velocity at any point to specify the pattern of motion seen by the pilot. This was done by plotting contours of equal angular rate. The hypothesis was then made that the expected error in detecting the aim point would be a linear function of the angular distance from the aim point to some threshold angular rate. Initial results of an experimental study in which subjects viewed a pattern of dots that simulated the apparent expansion pattern of the ground tend to confirm this hypothesis. Author

N68-23326 Illinois Univ., Urbana.
ATTENTION IN THE IDENTIFICATION OF STIMULI IN COMPLEX VISUAL DISPLAYS
Joseph Stephens Lappin 1966 40 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6654

The identification of three stimuli embedded in brief visual displays was studied under conditions varying the relationship between the relevant stimuli. The stimuli and responses themselves were same in all conditions. Displays were circular arrays of nine three-dimensional objects, and were presented to the fovea for exposure durations shorter than voluntary eye-movement latencies. In different blocks of trials, the stimuli were either all three dimensions (size, color, and angle) of a single object, a different dimension of each of three objects, or the same dimension of three objects. In the conditions with three objects, these objects were located at either three adjacent or three separated positions on the display. Performance was found to be best when the stimuli were the three dimensions of a single object, and better when they were the same dimension than when a different dimension of each of the three objects. Dissert. Abstr.

N68-23328*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HUMAN INFORMATION PROCESSING RATES DURING CERTAIN MULTIAXIS TRACKING TASKS WITH A CONCURRENT AUDITORY TASK
T. E. Wempe and D. L. Baty [1967] 30 p refs Presented at the 4th Ann. Conf. on Manual Control Systems, Ann Arbor, Mich., 21–23 Mar. 1968
(NASA-TM-X-61085) CFSTI: HC $3.00/MF $0.65 CSCL 05H

A series of experiments were conducted to determine the information processing rates of several subjects performing one and two axis compensatory tracking tasks with a secondary auditory task. The experimental variables were the order of controlled element dynamics, the forcing function and the addition of a secondary task. Human information processing rates decreased on each tracking channel with the addition of the second tracking channel or the secondary auditory task. Other than this effect, the information processing channels were additive like parallel channels until a limit in the total information processing rate was reached. This limit was related to the order of the controlled element. Author

N68-23329*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SYNTHESIS OF HUMAN RESPONSE IN CLOSED-LOOP TRACKING TASKS
James J. Adams [1968] 12 p refs Presented at the 4th Ann. Conf. on Manual Control Systems, Ann Arbor, Mich., 21–23 Mar. 1968
(NASA-TM-X-61084) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Previous investigations have determined linear, average constant-coefficient models that provided a reasonable reproduction of a human controller's response in tracking tasks. However, when such models are put in a control loop in place of a human, they do not exactly reproduce the system response obtained with the human controller. These previous studies suggest that time variations of the model coefficients and a random noise signal should be added to the linear model to obtain a more accurate representation of the human's response. In this present study, experiments have been conducted to determine the variability in a human subject's control stick response to displayed displacement and rate of change of displacement to aid in the implementation of the time variations to be included in the model. Also, additional tracking tasks were added to the model. These two factors were then added to the model, and this composite model was placed in a control loop in place of the pilot. The results demonstrate that this composite model reproduces time-history characteristics and mean-square system errors which more closely match the human subject than does the linear model. Author

N68-23385 Purdue Univ., Lafayette, Ind.
INTER-SENSORY INTERACTION AND VIGILANCE IN A BI-MODAL, NON-REDUNDANT SIGNAL DETECTION TASK
Max Harold McDaniel (Ph.D. Thesis) 1966 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-5459

Twenty subjects performed a simultaneous, non-redundant, visual and auditory signal detection task, twenty-five minutes a day for nine consecutive days. Independent variables manipulated were visual signal frequency, visual inter-signal interval variability, and auditory signal frequency. Primary dependent variables were average reaction times per session and proportion of signals missed. Inter-sensory interaction was found. Increases in frequency of the auditory signal caused decreases in both reaction time to the visual signal and proportion of visual signals missed. Decreases in the variability of the visual signal appeared to decrease reaction time to the auditory signal. The "activation" and "expectancy" hypotheses successfully predicted effects of signal frequency and signal variability, respectively. As signal frequency (level of activation) increased, vigilance performance improved. Signal frequency and variability tended to have the same effects between modalities as within modalities. Dissert. Abstr.

N68-23387 Illinois Univ., Urbana.
STIMULUS-INTENSITY AND ADAPTATION-LEVEL AS DETERMINANTS OF SIMPLE REACTION TIME
David Lloyd Kohfeld (Ph.D. Thesis) 1966 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6650

The results of a number of experiments indicate that simple reaction time (RT) undergoes a systematic decrease with a corresponding increase in stimulus-intensity. Along these lines, RT was investigated within the framework of adaptation level (AL) and stimulus-intensity effects. Subjects were preadapted to either 35, 65, or 100 decibel (db), sound pressure level, tones, to a random combination of the three (35–65–100 db), or to silence (control). A reaction test series of 35, 50, 65, 85, and 100 db tones was presented at random immediately afterward. It was hypothesized that subjects preadapted to a 65 db tone would perform similarly to those preadapted to either the 35–65–100 db combination or to silence. It was predicted that the group with an AL of 100 bd should produce the slowest mean RT, whereas the 35 db group should have the fastest mean RT. The results confirmed the experimental hypothesis and were thus consistent with an AL interpretation of stimulus-intensity effects. Dissert. Abstr.

N68-23389 Mississippi Univ., University.
DETECTION OF MONAURAL SIGNALS AS A FUNCTION OF INTERAURAL NOISE CORRELATION AND SIGNAL FREQUENCY
John Kenneth Whitmore (Ph.D. Thesis) 1966 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-6454

The effects of varying the interaural correlation for noise on the detection of 150, 200, 225, 240, 500, 1200, 3000, and 4000 Hz, monaural, 200 msec., tonal signals were investigated. Correlations of +1.00, +0.90, +0.75, +0.50 +0.25, and zero were obtained by mixing correlated and noise in the channels to the two ears. A yes-no, rating-scale procedure was used to obtain masking-level differences (MLD's) relative to purely monaural detection (Nm Sm). The results show that the magnitude of the binaural advantage for detection depends on the frequency of the signal and the interaural correlation of the masking noise. With correlated noise (NO Sm) signal frequencies of 225, 250, 500, and 1200 Hz are superior to Nm Sm by about 6, 9.5, 8, and 4.5 dB respectively. These MLD's diminished rapidly as the correlation of the noise was decreased from unity. At 200 Hz, the maximum MLD is about 3 dB. MLD's of about 2 dB were obtained for signals of 3000 and 4000 Hz. Dissert. Abstr.

N68-23408*# Franklin Inst., Philadelphia, Pa. Research Labs.
SPACE RELATED BIOLOGICAL AND INSTRUMENTATION STUDIES Annual Report, Mar. 1967–Mar. 1968
R. J. Gibson, Jr. and R. M. Goodman Mar. 1968 104 p refs
(Contract NSR-39-005-018)
(NASA-CR-94542; A-B2299-2) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The application of loop antennas for use with magnetic induction telemeters is discussed, along with the theoretical calculations used in deriving design approximations. Signal strengths for various antenna configurations were measured, and various circuit arrangements for improving the signal and/or reducing the noise are assessed. The temperature versus pulse count from a typical temperature telemeter is approximated, and the calibration curves are plotted. Experimental and developmental efforts continued on the low cost, high reliability, multichannel implantable telemeter, with emphasis placed on the evolution of micropower subcarrier oscillators. Summary data are provided on the design criteria for fully autoclavable brain temperature probes, requiring a small telemeter to be attached externally to the subject, and a receiver–recorder console for acquiring the transmitted signal from the telemeter and presenting a linear record of brain temperature. Consideration is also given to the problems involved in producing magnetic fields for biological experiments and designing magnetic shields. M.G.J.

N68-23412# Little (Arthur D.), Cambridge, Mass.
TECHNIQUES AND MATERIALS FOR PASSIVE THERMAL CONTROL OF RIGID AND FLEXIBLE EXTRAVEHICULAR SPACE ENCLOSURES Final Report, Feb. 1966–May 1967
David L. Richardson Wright-Patterson AFB, Ohio AMRL Dec. 1967 113 p refs
(Contract AF 33(615)-3533)
(AMRL-TR-67-128; AD-666940)

The results of the analysis indicate that when an astronaut in a flexible enclosure (soft space suit) works on the surface of a large spacecraft, the temperatures on his external surface are markedly increased over those which occur when he is not near the spacecraft. Moreover, passive thermal control of the astronaut is not possible when he is near the spacecraft. The techniques investigated for thermally coupling an astronaut with his thermal control system include liquid cooled undergarments, gas cooling, and heat transfer to the cooled walls of his enclosure. Techniques were investigated for increasing the conductance through soft space suit insulations by compressing the insulation. The insulation of a cylindrical section of a space suit arm was measured under both compressed conditions (3.7 psia) and uncompressed conditions in simulated noon and earth-umbra orbit-positions. The range of conductance increased from 0.26 Btu/sq ft-hr degrees F uncompressed to 0.81 Btu/sq ft-hr degree F compressed. Measurements were made in simulated noon and earth-umbra orbit positions of the thermal heat dissipating capability of a louver system which was designed for operation in the sun. A 6-inch square model had a net heat flow from the louvers for the four orbit conditions tested (open and closed in the sun and in the shade). The louver operation controls maintained the louver baseplate temperature in the range from 73.9 to 84.7 F for a steady heat dissipation rate of 93.5 Btu/sq ft-hr while operating in the shade. Author (TAB)

N68-23444*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
SOME SPECULATIONS ON STORAGE AND RETRIEVAL PROCESSES IN LONG TERM MEMORY
R. C. Atkinson and R. M. Shiffrin 2 Feb. 1968 26 p refs Presented at Conf. on Res. on Human Decision Making, Moffett Field, Calif., 31 Jan–2 Feb. 1968
(Grant NGR-05-020-036)
(NASA-CR-94547; TR-127) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A brief outline of the memory system is followed by somewhat speculative proposals for storage and retrieval processes, with particular care being given to distinguishing structural components from control processes set up and directed by the subject. The memory trace is conceived of as an ensemble of information, possibly stored in many places. For a given set of incoming information, the questions dealt with are whether to store, how to store, and where to store; the last question in particular deals with storage along various dimensions. Retrieval consists of a search along storage dimensions utilizing available cues to limit the search area and provide appropriate entry points. Both storage and retrieval are considered to take place in two steps, one consisting of a highly directed process under control of the subject and the other consisting of a pseudo-random component. Author

N68-23471# General Electric Co., Syracuse, N. Y. Electronics Lab.
SIGHTING RANGE OF TARGETS AGAINST THE NIGHT HORIZON SKY
C. Townsend Mar. 1967 31 p refs
(R67ELS-24)

A series of graphs have been prepared giving the sighting range of targets viewed against the horizon sky at night versus horizon sky luminance. A range of target sizes, target to background contracts and meteorological ranges are considered for the case of 95% detection probability. Author

N68-23653# Hawaii Univ., Honolulu. East-West Center for Cultural Exchange.
INTERNATIONAL CONFERENCE ON METHODOLOGIES OF PATTERN RECOGNITION Scientific Interim Report
Michael S. Watanabe 26 Jan. 1968 64 p refs
(Grant AF-AFOSR-68-1379)
(AFOSR-68-0515; AD-666679)

The document contains the program and abstracts of papers presented at the International Conference held at the University of Hawaii on January 24 - 26, 1968. The papers are concerned with theoretical foundations of pattern recognition methodologies, and consider, inter alia, the selection of variables, definitions of class features, limitations on domains of applicability of algorithms, assessments of decision-making procedures, and measures of goodness of variables. A proceedings volume is being undertaken. Author (TAB)

N68-23658# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
RADIOACTIVE AEROSOLS IN SOME SELECTED AREAS AT A.E.R.E. PARTICLE SIZE DISTRIBUTIONS AND LONG TERM MEAN CONCENTRATIONS MEASURED BY PERSONAL AND STATIC AIR SAMPLERS
D. C. Stevens Jan. 1968 20 p refs
(AERE-R-5688) HMSO: 3s

Centripeters and personal air samplers were used to measure the particle size of radioactive aerosols in various buildings and to examine the relationship between personal exposure and exposure measured by an environmental (static) sampler. The activity median aerodynamic particle diameter associated with the airborne activity in the incinerator building and filter house was 5 to 6 μm for both alpha and beta activity with a geometric standard deviation of 2.5 to 3.0. Similar size distributions were obtained for beta activity in the high activity handling building and the wet decontamination area but airborne alpha activity in the latter had a median diameter of 3.5 μm with a geometric standard deviation of 4.3. The air concentrations were statistically analysed, and the convenience of the log-normal distribution is demonstrated. It is shown that in areas where the source of airborne contamination is widespread and not directly associated with particular operations, the long term mean exposure indicated by personal samplers is similar to that indicated by the static (centripeter) sampler. However in an area, such as the decontamination area, where each man generates a localized aerosol, the mean exposure indicated by personal samplers is often 10 or more times higher than that shown by a static sampler. Author

N68-23714*# Baylor Univ., Houston, Tex. Urology Div.
MODIFICATION OF NASA URINE COLLECTING SYSTEM Final Report, 1 May 1966–1 Apr. 1968
Russell Scott, Jr. 9 Apr. 1968 44 p
(Contract NAS9-6206)
(NASA-CR-92105) CFSTI: HC $3.00/MF $0.65 CSCL 06B

This project involves four areas of research in development of an improved system of in-flight urinary collection. Anatomical form fitting condoms have been developed to reduce potential leakage and improve comfort. Methods of production are described and photographs provided. A design has been proposed for a urine collection system close-coupled to the suit of the astronaut. Observations on bacterial growth, turbidity, and alkalinity of initially sterile urine are discussed. Recommendations are made for an additive solution for control of these factors. Skin irritation from leaked urine is a potential in-flight problem. Upon advice from dermatologic consultants, a suitable commercial product is recommended to avoid this complication. Developmental concepts are discussed regarding a garment which would provide for absorption of leaked urine. Suitable sources for further development in this area are suggested. Author

N68-23784# Applied Psychological Services, Wayne, Pa. Science Center.
VISUAL DATA RELEVANT TO AIRCRAFT CAMOUFLAGE, LITERATURE SURVEY Interim Report
Dorothy E. Fletcher and Arthur I. Siegel Johnsville, Pa. Naval Air Develop. Center 18 Mar. 1968 129 p refs
(Contract N00156-67-C-2011)
(NADC-AC-6806; AD-667838)

The psychological literature, relevant to developing military aircraft surface camouflage schemes to minimize visual detection, identification, and/or estimation ranges under varying conditions, is surveyed. The survey considers brightness, hue, saturation, spatial, temporal, and movement judgments and factors that affect attention. Special attention is given to prediction problems, specific areas requiring further research, and control and maintenance functions. Author (TAB)

N68-23785# RAND Corp., Santa Monica, Calif.
COLOR DISCRIMINATION IN STATIC DISPLAYS
J. J. Sheppard, Jr., H. L. Moshin, R. H. Stratton, D. Dugas, and A. Madansky Nov. 1967 90 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(RM-5303-ARPA; AD-667592)

A description is presented of an experimental test of the color discrimination ability of a group of untrained observers in a simulated display situation in which stationary targets on a constant background are viewed. Just-noticeable-differences (JNDs) in saturation at constant brightness were determined for 39 subjects for each of six hue series about the 3200K tungsten achromatic point. The results indicate that human chromaticity discrimination ability is only moderately degraded for widely separated 1/3-deg target spots in a dark field subtending 17 deg. Evidence of tritanopic effects was found with the 1/3-deg targets, but the effects were moderate and are approximately accounted for in a scaling procedure. These findings may be applicable not only to the monitoring of reentry vehicles, but to other similar display situations in which color is used as an additional dimension. Author (TAB)

N68-23808# General Electric Co., Philadelphia, Pa.
VACUUM DISTILLATION, VAPOR PYROLYSIS WATER RECOVERY SYSTEM UTILIZING RADIOISOTOPES FOR THERMAL ENERGY Final Report, 5 May–4 Jul. 1967
H. Esten, R. W. Murray, and L. Cooper Wright-Patterson AFB, Ohio AMRL Nov. 1967 94 p
(Contract AF 33(615)-3308)
(Doc.-67SD8124; AMRL-TR-67-80; AD-667571)

A laboratory prototype system for producing, storing and dispensing potable water derived from urine and wash water was designed, fabricated, and tested. The design incorporated the previously established technique of vacuum distillation of liquid wastes followed by pyrolysis of the steam in the presence of a catalyst. For the first time, radioisotope heat sources (containing Plutonium 238) were employed in both the evaporator and pyrolysis sections to minimize the electrical power requirements for a potential space application. The system was also designed to utilize electrical and waste heat sources and is capable of zero gravity operation. The basic process demonstrated its feasibility for long duration operation producing high quality potable water. Peripheral equipment, such as, liquid level sensors, and phase separators need further development. Unit weight was 120 pounds and power consumption was 56 watt-hours per pound of water recovered. A flight optimized design using isotopes would weigh 58 pounds and consume 8 watt hours per pound of water recovered.
Author (TAB)

N68-23909 Aircraft Porous Media, Inc., Glen Cove, N. Y.
FILTERING SYSTEM FOR AEROSPACE WATER RECLAMATION Final Report, Apr. 1966–Jul. 1967
Klaus Feindler Wright-Patterson AFB., Ohio AMRL Dec. 1967 41 p refs
(Contract AF 33(615)-3862)
(AMRL-TR-67-157; AD-667552)

A study was conducted to provide design criteria for a system employing multifiltration for reclaiming bacteria-free potable water from wash water, dehumidification water, and water recovered from urine. Based on the design criteria developed, a laboratory model was constructed and tested. The laboratory model consisted of a transfer pump, filtration units, a storage tank, and a dispenser. It was designed to process 22 liters of water each day during a 36-day simulated aerospace mission, with no major maintenance, replacement of parts, cleaning, or calibration. Provisions were made for the replacement of expendable parts, when required, in order to operate for 180 days. Author (TAB)

N68-23969# Naval Air Development Center, Johnsville, Pa.
FLEET EVALUATION: COVERALLS, FLYING, SUMMER, FIRE RESISTANT, POLYAMIDE, TYPE CS-FRP-1
David N. DeSimone 9 Apr. 1968 18 p refs
(NADC-AC-6809; AD-667718)

A field evaluation was conducted in accordance with reference (a) on the subject coverall to obtain information regarding the acceptability of first production lots. One thousand questionnaires

were distributed to the Fleet and 621 were returned to the Aerospace Crew Equipment Department representing a cross section of various activities. Coverall design was found acceptable for Fleet use. Author (TAB)

N68-23972# Systems Technology, Inc., Hawthorne, Calif.
NEW APPROACHES TO HUMAN-PILOT/VEHICLE DYNAMIC ANALYSIS Final Report, Mar. 1966–Jun. 1967
D. T. McRuer, L. G. Hofmann, H. R. Jex, G. P. Moore, A. V. Phatak et al Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Feb. 1968 207 p refs
(Contract AF 33(615)-3652)
(STI-TR-164-2; AFFDL-TR-67-150; AD-667549)

New models for human pilot dynamics and new methods for pilot/vehicle dynamic analysis are investigated. The status of existing quasi-linear models is reviewed and deficiencies are noted as a basis for pinpointing areas needing the most effort. The pilot modeling topics explored include: low frequency lead generation using either velocity sensing at the periphery (eye) or difference computations accomplished at a more central level; mode-switching models for nonstationary or discrete inputs to the pilot/vehicle system; physiological aspects of pilot dynamics in tracking tasks; Successive Organization of Perception (SOP) theory for levels of pilot cognition higher than compensatory. For pilot/vehicle analysis, analytical approaches from control theory which appear to have promise are studied, including: time-optimal computing feedforward elements useful in the mode switching models for response to nonstationary inputs; optimal control theory using the crossover model in the performance criterion to estimate pilot response characteristics in compensatory tasks; inverse optimal control theory using known experimental results and quasi-linear pilot response models in an effort to define the pilots adjustment rules in terms of performance indices; optimal control theory to provide a simple test for optimality (to an elementary quadratic criterion) using only average performance measure data. Author (TAB)

N68-24041# Clarkson Coll. of Technology, Potsdam, N. Y. Dept. of Physics.
A STUDY OF THE THEORETICAL PERFORMANCE OF GASEOUS ADSORPTION SYSTEMS Final Report, Jul. 1966–Aug. 1967
Richard Madey and Joseph J. Charles Wright-Patterson AFB, Ohio AMRL Dec. 1967 104 p refs
(Contract AF 33(615)-5162)
(CPDD-67-86; AMRL-TR-67-198; AD-667811)

This study of the theoretical performance of gaseous adsorption systems is based on an equation for the time-dependent transmission of a gas through an adsorber bed of length, l, and bulk density, rho, and a gas-adsorber system characterized by an isothermal adsorption capacity, K, and a dispersivity, D. For a step-function gaseous input pulse injected into a stream of carrier gas which flows through the adsorber at a superficial flow velocity, u, the time-dependent expression for the transmission is a function only of the dimensionless dispersion number, D/ul, and the dimensionless time measured in units of the inflection time. A weighted least-squares analysis is developed and programmed on a digital computer to determine from an experimental transmission versus time curve the values of the two theoretical parameters (namely, the dispersivity and the adsorptivity) in the transmission equation. The errors in the values of the two theoretical parameters are evaluated also by propagating the errors in the experimental values of the transmission through the normal equations of the least-squares analysis. The Newton-Raphson method is used for obtaining the solution of the two simultaneous normal equations of the least-squares analysis. The theory is used to analyze experimental data on the transmission of carbon dioxide in air through molecular sieve adsorber beds. Author (TAB)

N68-24057 George Washington Univ., Alexandria, Va. Human Resources Research Office.
VISUAL DETECTION, IDENTIFICATION, AND LOCALIZATION: AN ANNOTATED BIBLIOGRAPHY
Bernard Lyman Feb. 1968 126 p refs *Its* Exploratory Study 27
(Contract DA-44-188-ARO-2)
(HumRRO-TR-68-2; AD-667500)

The literature survey was undertaken to explore information on the nature of and conditions for effective visual perception at low light levels. From the survey, 407 reports or studies were selected for inclusion in the annotated bibliography. With a few exceptions, the material falls within the areas of detection, identification, and localization. Many laboratory studies are included which could undergo appropriate modification for repetition in natural settings at low light levels. In each annotation the purpose and the results or conclusions of the study are stated; method and procedure are indicated only briefly. Author (TAB)

N68-24128# School of Aerospace Medicine, Brooks AFB., Tex. Biometrics Div.
THE NEGATIVE EXPONENTIAL WITH CUMULATIVE ERROR, JANUARY–AUGUST 1967
M. Bryan Danford and Harry M. Hughes Mar. 1968 28 p refs
(SAM-TR-68-29; AD-667789)

In certain tracer experiments, a biologist may inject a tagged substance in an animal and, among other things, measure the fraction of material excreted in the urine each day. Assuming the true value to be a negative exponential in time, two error models (homoscedastic vs. proportional error) and two methods of analysis (incremental vs. cumulative) are compared. The general conclusion is that one should be fairly sure which model is appropriate and should have a reasonable notion of the size of the rate constant beta relative to the length of the experimental run before attempting to estimate beta from a logarithmic transformation of the periodic increments or of the cumulative amount remaining. Author (TAB)

N68-24211# George Washington Univ., Alexandria, Va. Human Resources Research Office.
FLIGHT EVALUATION PROCEDURES AND QUALITY CONTROL OF TRAINING
Paul W. Caro, Jr. Mar. 1968 36 p refs
(Contract DA-44-188-ARO-2)
(TR-68-3; AD-667512)

Aspects of flight evaluation data input at the Rotary Wing Department, U.S. Army Aviation School, during 1961-63, were studied with reference to formal quality control system requirements. It was found that significant agreement did exist between instructor and checkpilot evaluations, but that this agreement could be a reflection of information available to the checkpilot prior to the checkride, rather than commonality of instructor and checkpilot standards. Checkride grades were also found to reflect individual checkpilot standards and the students stage of training. Current grading practices were studied to determine the usefulness, for quality control purposes, of the kinds of detailed diagnostic information available on individual student performance. Author (TAB)

N68-24316# Library of Congress, Washington, D. C. Aerospace Technology Div.
AEROSPACE LIFE SUPPORT SYSTEMS AND CREW PROTECTIVE EQUIPMENT Surveys of Foreign Scientific and Technical Literature
D. Pyle and B. Mandrovsky Apr. 1968 62 p refs *Its* Work Assignment No. 22
(ATD-68-6-22-1)

The first part of this report contains a section on flight clothing suitable for various seasons of the year, gloves and foot gear, helmet liners, ventilated suits, anti-G suits, and survival

equipment (sea survival gear, survival suits, life jackets, life rafts, and an emergency survival pack). The second part of this report contains 30 abstracts related to spacecraft life-support systems. They deal largely with recent developments in Soviet *Chlorella* research which are directly applicable to the use of *Chlorella* for regeneration of spacecraft cabin air and to the possible use of algae as a source of food for cosmonauts on extended spaceflights. Author

N68-24339*# AiResearch Mfg. Co., Los Angeles, Calif.
PROJECT GEMINI: EXTRAVEHICULAR LIFE SUPPORT SYSTEM (ELSS) Final Report, 30 Jan. 1964–31 Mar. 1967
W. J. O'Reilly Feb. 1967 384 p refs
(Contract NAS9-2412)
(NASA-CR-92066; Rept.-66-1483) CFSTI: HC $3.00/MF $0.65
CSCL 06K

The evaluated Gemini extravehicular life support systems permits the astronauts to perform a 20 minute outside operation with 5 minutes additional operation while sustaining a 10-cfm suit leak. The selected semi-open-loop system concept utilized three pneumatic loops, an evaporating-condensing heat exchanger, and a complete malfunction detector system in addition to wrist thrusters for field support. All qualification, interface, and pre-flight checkouts were completed throughout the program and the final chestpack assembly and its components performed satisfactorily. G.G.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-23054# Peninsular ChemResearch, Inc., Gainesville, Fla.
SYNTHESIS OF NEW FLUORINE-CONTAINING NITROSO COMPOUNDS, COPOLYMERS AND TERPOLYMERS Final Report, Jul. 1963–Nov. 1966
Eugene C. Stump and Calvin D. Padgett Natick, Mass. Clothing and Organic Mater. Lab. Nov. 1967 122 p refs
(Contract DA-19-129-AMC-152(N))
(TR-68-33-CM; AD-666801)

The report describes work carried out in the area of nitroso polymers. Two general classes were investigated. These were (1) sulfur-containing nitroso polymers and (2) nitroso polymers containing functional groups. Synthesis of a wide variety of fluorine-containing nitroso compounds and olefins is described, as well as the synthesis of various fluorine-containing intermediates. Nitroso copolymers and terpolymers were prepared containing functional groups such as halogen, ester, double bonds, and methoxy. Properties of selected systems are described. A terpolymer which could be cross-linked by peroxide was prepared using methyl 4-nitrosoperfluorobutyrate as the termonomer. Infrared spectra and NMR analysis of the new monomers and polymers are included. Author (TAB)

N68-23081 California Univ., Berkeley.
THE MOLECULAR STATE OF PERCHLORIC ACID AND THE HYDRATION OF THE HYDROGEN ION
Richard William Duerst (Ph.D. Thesis) 1966 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5046

The proton magnetic resonance shift of dilute perchloric acid, which varies with the deuterium content, has been shown in recent investigations to furnish information regarding the hydration of the hydrogen ion. More extensive and accurate data are likely to promote the application and further development of this method. The present work presents the experimental basis for a discussion of these problems. The proton magnetic resonance has been measured between zero and 67°C for the whole ternary system $HClO_4$–$DClO_4$–H_2O–D_2O. Preliminary values were obtained for the degree of dissociation of perchloric acid. The data provide evidence that various hydrated forms of the proton are present in solution depending on the concentration of the acid. Dissert. Abstr.

N68-23082 California Univ., Los Angeles.
A STUDY OF THE ELECTROCHEMICAL KINETICS OF ANTIMONY
Leonard Lee Wikstrom (Ph.D. Thesis) 1966 190 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-4470

The electrochemical kinetics of antimony in inert, Sb(III) and Sb(V) acid and alkaline solutions were studied. By the measurement of the Tafel slopes and rest potentials with various concentrations of Sb(III) and Sb(V) at different pH values, the exchange current densities, electrochemical reaction orders (with respect to H^+, Sb(III) and Sb(V)), the stoichiometric coefficients (for H^+, Sb(III) and Sb(V)), the apparent number of electrons transferred in the rate determining charge transfer step, and the charge transfer coefficients were determined for the redox reaction occurring at the rest potential, Sb(III) deposition reaction, and hydrogen evolution reaction in acid and alkaline solutions. From potentiodynamic polarization in inert acid solution, the electrochemical reaction order with respect to H^+, the apparent number of electrons transferred in the rate determining charge transfer step, and the charge transfer coefficient of the Sb_2O_3/Sb_2O_5 redox reaction were determined. Dissert. Abstr.

N68-23095 Stanford Univ., Calif.
THE DIFFUSION OF HYDROGEN IN LIQUID IRON
Nabil Mohammed Mohammed El-layeb (Ph.D. Thesis) 1966 217 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-4345

The diffusion rate of hydrogen in liquid iron has been determined by the gas-liquid metal diffusion cell technique. The appropriate solution to Fick's second law was used to examine the data and calculate diffusivities. The absorption of hydrogen in stagnant pure liquid iron was found to be diffusion controlled. Results show that the chemical diffusion coefficient of hydrogen in pure iron in the range 1547°–1726°C can be represented at a 90% confidence level using the Arrhenius relation. The same method was used to investigate the diffusion of hydrogen in iron-carbon melts, and the diffusion of nitrogen in liquid iron. Existing diffusion theories do not account for the high diffusivities of hydrogen in solid and liquid iron. This suggests that the diffusion mechanism for hydrogen is considerably different from other elements. Several diffusion mechanisms for hydrogen are suggested in qualitative form. Dissert. Abstr.

N68-23105 Lehigh Univ., Bethlehem, Pa.
AN EXPERIMENTAL AND CORRELATIVE STUDY OF THE VAPOR-LIQUID EQUILIBRIA OF THE TETRAFLUOROMETHANE–TRIFLUOROMETHANE SYSTEM
Arnold Piacentini (Ph.D. Thesis) 1966 175 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-4876

An apparatus for determining vapor-liquid equilibria at cryogenic temperatures and high pressures was constructed. The design is based on the vapor-recirculation technique. Experimental vapor-liquid equilibrium data for the tetrafluoromethane–trifluoromethane binary were determined at −198.4, −150, −100, −55, 0, and 50°F. In the critical region, data were obtained up to the critical

pressure of the mixture. The data which could be tested were found to be thermodynamically consistent. The data were correlated as a function of composition and temperature. The vapor phase was described by the Martin–Hou equation of state and the resulting liquid-phase activity coefficients were correlated with the Redlich–Kister equation. This correlation accurately predicts vapor-liquid equilibria for this system between −200 and 50°F. Pressure-composition diagrams were calculated at 10°F increments over this range. Dissert. Abstr.

N68-23117# Ludwig-Maximilians-Universitat, Munich (West Germany). Institut fuer Anorganische Chemie.
COMPARATIVE CHEMISTRY OF LANTHANIDE AND ACTINIDE ELEMENTS [JAHRESBERICHT 1966 UEBER FORTSCHRITTE IN DER VERGLEICHENDEN CHEMIE DER LANTHANIDEN- UND AKTINIDENELEMENTE] Annual Progress Report, 1966
Oct. 1967 12 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-87)

Progress in comparative chemistry of lanthanide and actinide elements is reported. The vapor phase hydrolysis measurements of the lanthanide(III) chlorides $ErCl_3$, $TmCl_3$, YCl_3, and $PmCl_3$ were evaluated, the thermodynamic data thus obtained are reported. The x-ray data obtained for $Nd_2(C_2O_4)_3 \cdot 10H_2O$ and $Sm_2(C_2O_4)_3 \cdot 10H_2O$ in 1965 were revised using Weissenberg, Buerger, and rotating crystal photographs. The space group was unambiguously found to be $P2_1/c$, the lattice constants of completely reduced unit cells could be determined for $Nd_2(C_2O_4)_3 \cdot 10H_2O$, $Pm_2(C_2O_4)_3 \cdot 10H_2O$, and $Sm_2(C_2O_4)_3 \cdot 10H_2O$. A special working enclosure for Ra-226 work is briefly described. The reactions observed in treatment of UCl_4 with borane are reported. The unit cell of $Am_2(C_2O_4)_3 \pm 10H_2O$ was determined. Am(III) formate, $Am(HCOO)_3$, and Am(III) carbonate dihydrate, $Am_2(CO_3)_3 \cdot 2H_2O$, were synthesized and were identified by their x-ray powder patterns. The thermal decomposition of $Am_2(CO_3)_3 \cdot 2H_2O$ was studied in a mass spectrometer. A molybdenum cup apparatus for vapor pressure determinations was built and calibrated using $SnCl_2$ as standard. Author (NSA)

N68-23133 Baylor Univ., Waco, Tex.
THE EFFECT OF ELECTRODE PREPARATION, PRETREATMENT, AND SOLUTION VARIABLES ON THE ADSORPTION CHARACTERISTICS AND POTENTIAL OF THE HYDROGEN ELECTRODE
Takuji Itoh (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-2928

An investigation was made of the adsorptive properties of hydrogen on bright and platinized platinum electrodes with different roughness factors and the effect of adsorbed hydrogen on the electrode potential. From the results of the determination of the heat of adsorption and from the current-voltage curves for the oxidation of adsorbed hydrogen it was found that there are at least three forms of adsorbed hydrogen. One form was proven to be molecular hydrogen. The other two forms, in agreement with a previous postulate, were demonstrated to be adsorbed atomic hydrogen. A study was also made of the effects of poisons upon the adsorptive properties of hydrogen on a platinum electrode and upon the electrode potential. It was found that the relationship between the amount of adsorbed hydrogen and the electrode potential obtained in the absence of poisons was no longer valid in the presence of a specifically adsorbed anion or dipole. Dissert. Abstr.

N68-23156# Kansas Univ., Lawrence. Dept. of Chemistry.
RADIATION CHEMISTRY OF FROZEN AQUEOUS SOLUTIONS
Larry Kevan 1 Dec. 1967 99 p refs Presented at 19th Farkas Mem. Symp., Jerusalem, 27–29 Dec. 1967
(Contract AT(11-1)-1528)
(COO-1528-18; CONF-671212-1) CFSTI: HC $3.00/MF $0.65

Radiolysis of pure ice, alkaline ice glasses, acid ice glasses, and solute-containing glasses is reported. Topics covered include: identification of trapped intermediates, EPR spectra, decay of intermediates, yields of radiolytic products, isotope effects, scavenger effects, phase effects, thermal decay, and hole reactions. NSA

N68-23158 California Univ., Berkeley.
THE DYNAMICS OF A PACKED TUBULAR CHEMICAL REACTOR
John Earl Crider (Ph.D. Thesis) 1966 282 p
Available from Univ. Microfilms: HC $12.85/MF $3.65 Order No. 67-5038

This is an analytical and numerical study of the dynamic behavior of a packed bed tubular chemical reactor. Concentration and temperature transients for three different mathematical models of the reactor are calculated and compared. Two of the models represent the reactor as an array of continuous-flow, perfectly mixed stages; one model is two-dimensional, the other one-dimensional. The third model is a one-dimensional differential representation without axial fluid dispersion. The chemical reaction is an exothermic, homogeneous, liquid phase reaction. Machine calculations of transients following step changes in feed temperature or concentration show that the effects of axial fluid dispersion are small compared with the dispersive effects of heat transfer between fluid and packing. An analytic solution for the unsteady-state equations of the one-dimensional differential model was obtained for an adiabatic reactor after linearization of the model equations about the steady-state operating conditions and application of the coupling parameter approximation. Dissert. Abstr.

N68-23159 Virginia Univ., Charlottesville.
FREQUENCY-DOMAIN RESPONSE OF PULSED COLUMN EXTRACTORS
John Carlton Hale (Ph.D. Thesis) 1966 206 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-3776

Pulse testing has been applied to pulsed sieve-plate extraction columns to obtain the frequency-domain response of concentration to changes in concentration and flowrate. A distributed-dye system, 1-butanol–aqueous NaCl–Acid Green 16 dye, was used in conjunction with colorimetric monitoring of one input and two output streams. Dissert. Abstr.

N68-23177 Connecticut Univ., Storrs.
THEORETICAL INVESTIGATION OF A RADIATION-INDUCED MOLECULE–ION IN ALUMINUM OXIDE
Joseph Theophile Fournier, Jr. (Ph.D. Thesis) 1966 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4550

A theoretical study of the electronic structure of an AlO_3 molecular ion stabilized in a double anion vacancy of the Al_2O_3 lattice has been undertaken for the purpose of determining the suitability of this ion as a model for part of the spin resonance spectrum observed in neutron-irradiated A_2O_3. A molecular orbital approach has been employed using MO's constructed from oxygen 2s and 2p and aluminum 3s and 3p wave functions. The interactions of the 12 valence electrons with each other and with the O^{6+} and Al^{3+} cores have been approximated by a single-electron potential which is a sum of two atomic potentials. The atomic potentials are constructed from self-consistent wave functions for various oxygen and aluminum ions which were taken from the literature. An a-priori calculation of the crystal potential is performed on a point ion model, and the crystal energy is included in the Hamiltonian defining the molecular system. Dissert. Abstr.

N68-23198# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
HYGROSCOPICITY OF PLUTONIUM DIOXIDE
Jerry L. Stakebake and Marston R. Dringman 19 Jan. 1968 11 p refs
(Contract AT(29-1)-1106)
(RFP-1056) CFSTI: HC $3.00/MF $0.65

Investigations were initiated to explore more fully the mechanisms of plutonium oxidation and to identify, if possible, the hygroscopic properties of plutonium dioxide. Earlier studies were limited and do not completely define the various interactions within such a system. Quantitative and qualitative data are given on the rate and amount of adsorption of water on plutonium dioxide obtained from experiments at 25, 50, and 75°C. Underlying a reversible physical process, evidence indicates a chemisorption of the water molecules to the surface. Possible adsorption mechanisms are discussed. Author (NSA)

N68-23201*# West Virginia Univ., Morgantown. Dept. of Chemistry.
SEQUENCE DISTRIBUTION STUDIES OF DICHLOROPROTO-ANEMONIN–METHYL METHACRYLATE COPOLYMERS
A. Winston, D. A. Chapman, and G. T. C. Li [1967] 7 p refs
(Grant NsG-533)
(NASA-CR-94533) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Good agreement between amount of chloride eliminated as HCl and amount retained in newly prepared DCPA–MMA (dichloroprotoanemonin–methyl methacrylate) copolymers confirms a previous observation that half of the chloride is eliminated on copolymerization of DCPA with MMA. Slightly higher values reported for chloride elimination are attributed to errors from the inability to isolate completely all the copolymers formed. In addition to the intense ultraviolet band at 300 m μ, DCPA–MMA copolymers exhibit a weak band at 368 m μ, which indicates that more extended conjugated structures may be present than the three double bond conjugated system of structure IV. These structures may possibly be DCPA residue diads (VI) which, having a six double bond conjugated system, would be expected to absorb at about the observed position. In the case of DCPA-styrene copolymers, distinct absorption peaks above 300 m μ are completely lacking; and, here, the probability of diad formation is extremely low. M.W.R.

N68-23207# Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics.
INCORPORATION OF RADIOACTIVE TRACERS DURING CONTROLLED GROWTH OF MONODISPERSE SILICA PARTICLES
Werner Stoeber 5 Dec. 1967 9 p refs Presented at the 13th Meeting on Bioassay and Anal. Chem., Berkeley, Calif.
(Contract W-7405-ENG-49)
(UR-49-867; CONF-671048-1) CFSTI: HC $3.00/MF $0.65

Tetraalcyl esters of silicic acid in alcoholic solutions react with water in the presence of ammonia in such a way that the hydrolysis of the ester is subsequently followed by a condensation of the silicic acid causing a growth of silica particles. Attempts were made to incorporate radioactive tracers into the bulk of the spheres by inclusion or substitution in the framework of the SiO_4 tetrahedrons during growth of the silica particles. Results for studies of incorporation of ^{134}Cs, ^{54}Mn, ^{65}Zn, ^{124}Sb, and ^{59}Fe are given. NSA

N68-23216 Stanford Univ., Calif.
ELECTRON TRANSFER THROUGH CONJUGATED ORGANIC LIGANDS
James Kendall Hurst (Ph.D. Thesis) 1966 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4372

The reactions of pentaamminemethylfumaratocobalt(III) with chromous, vanadous and cuprous ions were reinvestigated. Contrary to previous reports, hydrolysis of the ester function is found not to accompany reduction of the cobalt center. Similary, reduction of pentaamminemethylterephthalatocobalt(II) by chromous ion does not cause ester hydrolysis. The predominant chromic reaction product contains the organic ligand bound to the pentaaquochromium(III) moiety by the carboxylate group. A mechanism is proposed by which chromous ion might associate initially with the ester group of the coordinated organic anion and then undergo rearrangement to the observed reaction product. Specifically, electron transfer through the unsaturated carbon chain is thought to form an ester-bound chromic species; this intermediate then reacts with chromous ion in a second electron-transfer step to form the carboxylate-bound product. A competitive reaction, that of spontaneous aquation of the intermediate, is also postulated. Dissert. Abstr.

N68-23258# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
A FLUORINE-19 NMR STUDY OF SOME DIADDUCTS OF TITANIUM TETRAFLUORIDE Technical Report, Jun. 1964–Jan. 1967
Daniel S. Dyer Dec. 1967 96 p refs
(AFML-TR-67-204; AD-666658)

Several series of the diadducts of titanium tetrafluoride were studied with high-resolution fluorine-19 nuclear magnetic resonance (nmr) spectroscopy. These series consisted of fluorotitantate complexes of formula TiF4.2(donor) and TiF5.(donor)(-1), where donor represents an organic molecule (Lewis base) which coordinates through oxygen. The TiF4.2(donor) adducts included both TiF4.2D (D = donor) complexes, in which the donors are identical, and TiF4.D,D complexes, in which D and D represent different Lewis bases. Fluorine-19 chemical shifts and spin-spin coupling constants were determined for most of these fluorotitanate complexes. The temperature dependence of the TiF4.2D spectra was also studied. Author (TAB)

N68-23279# Los Alamos Scientific Lab., N. Mex.
SELF-DIFFUSION COEFFICIENT OF URANIUM MONOCARBIDE
Philippe Villaine and Jean-Francois Marin 17 Jan. 1968 5 p refs Transl. into ENGLISH from C. R. Acad. Sci. (Paris), v. 264, 19 Jun. 1967 p 2015–2018
(LA-TR-68-3) CFSTI: HC $3.00/MF $0.65

U diffusion profiles in UC were studied by a tracer method for temperatures between 1450 and 1980°C. The self-diffusion coefficient for stoichiometric UC is given by the expression $D = 7 \times 10^{-5} \exp - 80{,}000/RT$, the activation energy being 80 kcal/mole ± 10 kcal. This coefficient is much larger for substoichiometric carbides, much smaller for superstoichiometric carbides. Author (NSA)

N68-23285# Fordham Univ., New York. Dept. of Chemistry.
KINETICS AND STRUCTURAL STUDIES OF CHELATES β DIKETONES WITH TRANSITION AND RARE EARTH METALS Progress Report
Michael Cefola 1 Jan. 1968 19 p refs
(Contract AT(30-1)-906)
(NYO-906-80) CFSTI: HC $3.00/MF $0.65

In line with recent structural studies of the unusual eight coordination number of rare earth metals with β-diketones (4:1 ligand-to-metal ratio) in the form of ammonium salts, six coordinate zincate and cadmiate ammonium salts (3:1 ligand-to-metal ratio) were synthesized and complete x-ray structures will be determined. The ligand employed in the latter preparations was furoyltrifluoroacetone (FTA). Utilizing the Moessbauer effect, studies are currently in progress on the structures of acetylacetone and other β-diketone chelates of tin. Moessbauer measurements were

made on many chelates of this type as well as the sulfur analog of β-diketones and tin. Data are being gathered on the relation of the Moessbauer chemical shift parameter and the $^{119}Sn-H$ coupling constants in the chelates. Author (NSA)

N68-23289# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

MEASUREMENT OF PHOTOABSORPTION OF THE LITHIUM HALIDES NEAR THE LITHIUM K EDGE

R. Haensel, C. Kunz, and B. Sonntag Dec. 1967 9 p refs

(DESY-67142)

The fine structure of photoabsorption was measured in LiF, LiCl, LiBr, and LiI near the LiK edge (photon energy ≈60 eV). NSA

N68-23304# Delaware Univ., Newark. Dept. of Chemistry.

PRIMARY CHEMICAL PROCESSES IN THE RADIOLYSIS OF LIQUIDS Final Progress Report, 15 Sep. 1960–14 Sep. 1967

C. N. Trumbore 15 Jan. 1968 17 p refs

(Contract AT(30-1)-2668)

(NYO-2668-15) CFSTI: HC $3.00/MF $0.65

A summary of important research results and publications is given along with administrative details of the past contract year. Significant correlations have been made between product quenching rate constants in the photolysis and radiolysis of several liquid organic systems containing cyclopentanone, thus demonstrating the importance of excited states as radiolytic intermediates in the radiation chemistry of liquid organic compounds. An isotopic exchange reaction study showed the importance of unusual oxidation states of iodine produced by self radiolysis. A new and convenient system has been developed for studying relative rate constants of OH radicals with solutes in aqueous solutions. Unusual results in acid solutions of this system, oxygenated aqueous solutions of p-nitrosodimethylaniline, have caused speculation that there is another oxidizing species besides the OH radical or that there is a precursor to this radical in these acidic solutions. Pulse radiolysis studies using 20-nsec x-ray pulses have demonstrated an unusually fast decay of what is assumed to be the hydrated electron. This fast decay is very efficiently quenched by the addition of small quantities of added bromide ion. Arguments regarding the importance of structure of liquid water in radiation chemistry have been advanced because of these results. Author

N68-23308# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DETERMINATION OF PLUTONIUM IN PLUTONIUM ALUMINUM ALLOYS BY X-RAY FLUORESCENCE

M. Ganivet and Th. Arnal [1967] 10 p refs Transl. into ENGLISH from Anal. Chim. Acta (France), v. 39, 1967 p 73–79

(BNWL-TR-24) CFSTI: HC $3.00/MF $0.65

An X-ray fluorescence method is described for the determination of plutonium Pu–Al alloys. In order to obtain satisfactory reproducibility, the alloy was dissolved in a nitric acid–mercury(II) nitrate mixture. The Lα emission of plutonium was measured; to eliminate matrix effects, an internal standard with a wavelength near that of the Pu emission was used. Equipment and sample preparation are described. Extension of the method to other determinations is discussed. Author (NSA)

N68-23309# National Lead Co. of Ohio, Cincinnati.

ADAPTATION OF GAS CHROMATOGRAPHY TO THE IDENTIFICATION AND ESTIMATION OF RESIDUAL GASES IN HIGH-FIRED THORIUM OXIDE

W. G. Ellis 15 Sep. 1967 14 p refs Presented at the 11th Conf. on Anal. Chem. in Nucl. Technol., Gatlinburg, Tenn., 10–12 Oct. 1967

(Contract AT(30-1)-1156)

(NLCO-1006; CONF-671012-5) CFSTI: HC $3.00/MF $0.65

A gas chromatograph was adapted for use in identification and estimation of residual gases in high fired thorium oxide. A number of gases were identified by this means including water vapor, carbon monoxide, carbon dioxide, hydrogen sulfide, sulfur dioxide, and sulfur trioxide. Quantitative determination of the sulfur compounds was not achieved because of their incomplete dissociation at the temperatures available. This technique was successfully applied to the simultaneous determination of 10 to 100 ppM of water and carbon dioxide in thorium oxide. In this method the sample was heated to 950°C in a tube furnace. The evolved gases are concentrated by sweeping the ignition products into a precolumn packed with Porapak S, which is cooled in liquid nitrogen. At the end of the ignition period the products condensed in the precolumn are volatilized by heating and analyzed in a gas chromatograph using a thermal conductivity detector. Porapak S was satisfactory as the stationary phase in the chromatographic column. Author (NSA)

N68-23330# Iowa State Univ. of Science and Technology, Ames.

ELECTRON PARAMAGNETIC RESONANCE OF GADOLINIUM IN SODIUM SILICATE GLASSES

James Keith Johnstone (M.S. Thesis) Nov. 1967 67 p refs

(Contract W-7405-ENG-82)

(IS-T-213) CFSTI: HC $3.00/MF $0.65

The X-band (≈9800 Mhz) electron paramagnetic resonance spectra of gadolinium in sodium–silicate glasses at 77°K are presented. The spectra are characterized by peaks at g-values of g ≈ 2.0, 2.85 and 5.9. The experimental g-values are correlated with g-values obtained from the solution of the effective spin Hamiltonian. Comparison of the experimental and theoretical g-values indicates that the glasses have a two phase structure with each phase providing a characteristic symmetry site for the gadolinium ion. The possibility of a third symmetry site existing in the phase boundary is also discussed. Each symmetry site gives rise to one of the characteristic g-values obtained experimentally. Comparison of the relative intensities of the characteristic peaks of the spectra indicates definite trends toward ordering corresponding to compounds in the high soda phase. The solution of the effective spin Hamiltonian is presented. Author (NSA)

N68-23332# Denver Univ., Colo. Dept. of Physics.

COMPARISON BETWEEN EXPERIMENTAL AND CALCULATED SPECTRA OF CARBON DIOXIDE AND WATER VAPOR Interim Scientific Report

Thomas G. Kyle Feb. 1968 31 p refs

(Contract AF 19(628)-5202; ARPA Order 363)

(AFCRL-68-0105; SR-7; AD-660929)

Line by line calculations of absorption spectra were carried out for the 2.0 and the 2.7 micron bands of carbon dioxide and for the 2.7 micron band of water vapor. The parameters for these calculations are taken from published listings for these bands. The calculations are compared with experimental data of the same spectral resolution, this being a fraction of a wavenumber. The comparisons show the line positions to be in good agreement with the experimental data. The 2.0 micron bands of carbon dioxide differ from the calculations by a small amount, but adjustment of parameters is required for the experimental and calculated values to agree in the 2.7 micron bands of carbon dioxide. There are large differences between calculated and experimental spectra in the 2.7 micron band of water vapor throughout much of the spectra. Author (TAB)

N68-23339# Pennsylvania State Univ., University Park. Dept. of Chemistry.
ENTHALPIMETRIC ANALYSIS
Joseph Jordan and Peter W. Carr 14 Dec. 1967 6 p refs Presented at the 155th Symp. on Anal. Calorimetry, San Francisco
(Contract AT(30-1)-2133)
(NYO-2133-48; CONF-680404-1) CFSTI: HC $3.00/MF $0.65

Two calorimetric methods, thermometric enthalpy titration (TET) and direct injection enthalpimetry (DIE), are described. Both TET and DIE are ideally suited to the needs of organic functional group analysis. The limitations imposed by TET are: the heat of reaction must be large enough to produce an accurately measureable temperature change (0.01°C) in as short a time as possible, at the most 3 min; the heat of dilution of the titrant must be small as compared to the heat of reaction; and the titration curve should be controlled solely by equilibria and not by the rate of any slow chemical reaction. The first two limitations apply to DIE as well, but the kinetic limitation is not so severe since a large excess of reagent may be added to increase the overall reaction rate. At best, TET is capable of an accuracy and precision of 0.2 to 0.5% whereas DIE is best utilized when a precision of 3 to 5% is acceptable at millimolar concentration levels. The precision and accuracy of the two methods depends upon both heat of reaction and concentration. A method of obtaining useful analytical results in situations where the titration curve is significantly distorted by kinetics was developed. NSA

N68-23349*# Avco Corp., Lowell, Mass. Space Systems Div.
RESEARCH IN THE SYNTHESIS AND CHARACTERIZATION OF MAGNETIC FLUIDS, PHASE 2 Quarterly Report, Jan.–Mar. 1968
R. Kaiser Mar. 1968 39 p refs
(Contract NASw-1581)
(NASA-CR-94540; AVSSD-0038-68-CR; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The viscosity of different ferrofluids was measured in a 500 oe magnetic field. Application of a field results in an increase in viscosity which in one case was as low as 5%. Addition of sulfur chloride to a linseed oil fatty acid stabilized ferrofluid in order to form a polymerized "overshoe" around the individual particles, results in flocculation of the magnetic particles. The effect of solvation on fluid stability is discussed. Stable water-base and fluorocarbon-base magnetite ferrofluids were prepared by grinding. Encouraging results have been obtained in an attempt to prepare a silicon–iron ferrofluid. The effect of surfactant structure and solubility on magnetite/kerosene ferrofluids is discussed. Author

N68-23374# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SODIUM REMOVAL AND CLEANING OF REUSABLE HARDWARE
Leo E. Chulos Dec. 1967 12 p refs
(Contract AT(45-1)-1830)
(BNWL-637) CFSTI: HC $3.00/MF $0.65

Experiments were conducted to determine the efficiency of an alcohol-base commercial solvent, Dowanol-EB, for removing sodium from contaminated reusable hardware. The cleansing procedure is described. The results showed that Dowanol-EB provides a safe and flexible method for cleaning reusable parts contaminated with sodium and sodium oxide; that the reaction rate of sodium with Dowanol-EB can be regulated by water additions; and that the end products, liquid and residue, can be readily dissolved and flushed with water. NSA

N68-23386 California Univ., Berkeley.
SPECTROSCOPIC AND KINETIC STUDIES OF THE GAS-PHASE CARBON TRIFLUORIDE RADICAL WITH A RAPID-SCANNING INFRARED SPECTROMETER
Gary Alden Carlson (Ph.D. Thesis) 1966 240 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-5019

A study of flash photolytically produced CF_3 radical has been performed, using the rapid scan infrared spectrometer developed by Herr and Pimental. Modifications of the original instrument design are discussed which have significantly improved spectral resolution (now 2–4 cm^{-1} from 350 cm^{-1} to 1800 cm^{-1}) and have extended the low-frequency scan limit to 300 cm^{-1}, while maintaining microsecond scan times. The most significant modification has been the substitution of a rotating grating for the original-rotating mirror-prism dispersion system. Thermal design, construction details, and performance of a double dewar cryostat having a liquid hydrogen retention time of 120 hours are presented. The chemicals CF_3I, CF_3Br, $CF_3COC_6H_5$, CF_3SCl, CF_3NO, $(CF_3)_2CO$, and CF_3COCl were successfully flash photolysed. A kinetics study of the rate of disappearance of the 1260 cm^{-1} CF_3 absorption in CF_3I flash photolyses, and a similar study of the 1260 and 1087 cm^{-1} CF_3 absorptions in $CF_3COC_6H_5$ flash photolyses are also reported. Dissert. Abstr.

N68-23398* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATION OF PRIMARY PRODUCT QUANTUM YIELDS FOR PHOTOLYSIS REACTIONS OF GLASSY POLYMERS
R. F. Reinisch and H. R. Gloria [1967] 7 p refs Presented at the Am. Chem. Soc. Spring Meeting, Ablative Plastics Symp., San Francisco, 31 Mar.–5 Apr. 1968
(NASA-TM-X-61089) CFSTI: $3.00 CSCL 07C

A method proposed for calculating primary product quantum yields for photolysis reactions of glassy polymers irradiated with monochromatic or polychromatic light makes uses of photochemical rate constants based on bond dissociation energy. The definition of quantum yield is based on an order-of-magnitude analysis of the photochemical and photophysical processes that compete in the annihilation of the photoexcited singlet intermediate. Although the method was limited to glassy polymers, modification of relevant rate constants would permit its extension to rubbery polymers, naturally occurring macromolecules, inorganic polymers, and polymers in solutions. This semiempirical method indicates the molecular structural requirements for ultraviolet stable polymers by emphasizing that the dissociation energy of the weak bond and radiationless transitions are the dominant factors in determining the magnitude of the quantum yield. M.W.R.

N68-23466* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TABLES OF THEORETICAL LINE POSITIONS AND INTENSITIES FOR THE FUNDAMENTAL, FIRST OVERTONE, AND SECOND OVERTONE VIBRATION ROTATION BANDS OF $C^{12}O^{16}$ AND $C^{13}O^{16}$
Virgil G. Kunde Jun. 1967 480 p
(NASA-TM-X-63183; X-622-67-248) CFSTI: $3.00 CSCL 07D

Theoretical line positions and intensities are tabulated for the fundamental, first overtone and second overtone vibration-rotation bands of $C^{12}O^{16}$ and $C^{13}O^{16}$ for temperatures in the range 175–3500°K. Author

N68-23473*# Rocketdyne, Canoga Park, Calif.
PROPERTIES OF NONAQUEOUS ELECTROLYTES Sixth Summary Report, 20 Sep. 1967–19 Mar. 1968
Rudolf Keller, James N. Foster, Douglas C. Hanson, John F. Hon, Otto F. Kalman et al 19 Apr. 1968 70 p refs
(Contract NAS3-8521)
(NASA-CR-72407; R-6754-6) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Studies of aprotic electrolytes based on three solvents: propylene carbonate, dimethyl formamide, and acetonitrile, were continued. Characterized components were used to prepare the electrolyte solutions. Structural studies of electrolytes containing lithium chloride, aluminum chloride, and cupric chloride were performed utilizing nuclear magnetic resonance. The physical properties studies include solubilities, vapor pressures, diffusion coefficients, and dielectric constants. Author

N68-23520 Florida Univ., Gainesville.
STUDIES IN NUCLEAR RELAXATION
Aime Sylvester De Reggi (Ph.D. Thesis) 1968 254 p
Available from Univ. Microfilms: HC $11.50/MF $3.30 Order No. 67-360

A detailed spin-echo study of the quadrupolar relaxation in the PQR and NMR of ^{14}N in solid and liquid N_2 and in liquid NF_3 has been performed. The spin-lattice relaxation time T_1 in N_2 was measured over the temperature range $4.2°K \leq T \leq 92°K$. This range spans the two solid phases (fcc α-N_2 up to 35.6°K and hcp β-N_2 from 35.6°K to the triple point at 63.1°K), and the liquid phase up to $\approx$15°K above the normal boiling point. The pressure dependence of T_1 in liquid N_2 at 77.3°K and at 90.1°K has also been measured up to the fusion curve. Finally, the temperature dependence of T_1 in NF_3 from the triple point at 66.4°K to the normal boiling point around 144°K has been measured. Additional data obtained include the temperature dependence of the nuclear quadrupole coupling constant e^2qQ/h, the spin phase memory time T_2, and the inverse line width parameter T^*_2. Dissert. Abstr.

N68-23530 North Carolina Univ., Chapel Hill.
TRACER DIFFUSION IN A CHEMICAL CONCENTRATION GRADIENT IN SILVER-GOLD ALLOYS
Ralph Orrin Meyer (Ph.D. Thesis) 1966 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-1036

Self-diffusion coefficients D^*_{Au} and D^*_{Ag} in silver–gold alloys exhibit a broad minimum when plotted versus composition. This condition allows a detailed investigation of the effects of a vacancy flux and activity coefficient gradient on tracer diffusion, since a Kirkendall vacancy flux can be produced in a couple throughout which D^*_i is essentially constant. Four such experiments using gold tracer and four using silver tracer have been made, with the tracer deposited at the interface of couples prepared from compositions on either side of the minimum of D^*_i versus composition. Two additional experiments with gold tracer were made in homogeneous couples to investigate the effect of an impedance to free diffusion across a welded interface. The shift in center of gravity of the tracer activity profile was measured to within 3.5 microns relative to a radioactive hafnium oxide interface marker. To supplement the theory of Manning, an expression is obtained for the shift in center of gravity due to lattice distortion which results from the vacancy flow. When this expression is combined with the Manning equations, an expression for the total tracer profile shift results, and this is evaluated. Dissert. Abstr.

N68-23531 Minnesota Univ., Minneapolis.
TWO-PHASE LIQUID REACTIONS: OPTICAL STUDY OF THE DIFFUSION-CONTROLLED REACTION ZONE
Dae Hyun Cho (Ph.D. Thesis) 1966 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-853

Chemical reactions of two liquid phases were studied in one-dimensional, initially stagnant systems on a scale small enough to observe them in detail. The primary purpose was to: (1) Obtain a more detailed view of diffusion-controlled reaction zones resulting from contact of two reactive liquid phases, (2) Investigate the effect of interfacial turbulence and other interfacial phenomena on transfer rates and the reaction zone, and, conversely, the effect of chemical reaction on interfacial phenomena. Experimentation employed the Schlieren–Cylinder Lens-Inclined Knift Edge method. This gave directly profiles of refractive index gradients as a function of time in the contacted liquid phases. The reaction zone was identified on the profiles and traced with time. Direct observations of contacted interfaces (0.8 cm × 0.8 cm) were also made through a microscope. Dissert. Abstr.

N68-23544# Societe Belge Pour l'Industrie Nucleaire, Brussels (Belgium).
PURIFICATION OF PLUTONIUM WITH ION EXCHANGE RESINS [PURIFICATION DU PLUTONIUM PAR RESINES A ECHANGE D'IONS]
G. Valentini, N. Mostin, G. Stroo, L. Galer, and L. Taglioni Brussels EURATOM Mar. 1968 138 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-001-64-1 TRUB)
(EURAEC-1639; EUR-2840; EUR-2840.F) CFSTI: HC $3.00/MF $0.65

The present report describes the loading conditions of plutonium from nitric–fluorhydric solutions, free from metallic impurities on Permutit SK (20–50 and 40–70 mesh), Dowex 1 X1, X4, X10, Amberlite I RA 400 and Dowex 50 resin columns, thermostatized at 60°C. Then the washing operation and elution conditions of the adsorbed plutonium are dealt with. In order to explain experimental data, a theoretical interpretation of the exchange kinetics during loading and elution, is given. The second part treats the loading, washing and elution conditions of plutonium by means of a same resin column, but fed with nitric solutions containing metallic impurities such as zirconium, iron, uranium, molybdenum, etc. in variable ratios. The behaviour of these elements has particularly been studied during the washing operation. The decontamination factors obtained after one or two purification cycles are also reported. The plutonium absorption and desorption techniques under well-defined working conditions, the purification equipment required for the needs of the program, as well as the procedure and the material balance, and a comparison between the reprocessing procedure by means of ion exchangers, on the one hand, and by amines, on the other hand, are appended. Author

N68-23546# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
CHROMATOGRAPHIC DETERMINATION OF HYDROGEN ISOTOPES IN ZIRCONIUM ALLOYS BY CARRIER GAS EXTRACTION
R. Perkins and M. J. Morston-Smith Dec. 1967 9 p refs
(AERE-R-5606) HMSO: 1s 9d

A gas chromatographic method for the analysis of hydrogen isotopes in zirconium alloys is described. The apparatus utilizes carrier gas extraction and is capable of determining the hydrogen and deuterium content of 700 µl samples of mixed hydrogen isotopes containing 10 µl of the minor component to an accuracy of ±3%. Author

N68-23551 Florida Univ., Gainesville.
DERIVED EXPRESSIONS TO COMPARE ATOMIC FLUORESCENCE FLAME SPECTROMETRY WITH OTHER FLAME SPECTROMETRIC METHODS
Michael Loewen Parsons (Ph.D. Thesis) 1968 244 p
Available from Univ. Microfilms: HC $11.05/MF $3.15 Order No. 67-363

An introduction to the history of atomic fluorescence as an analytical technique is presented. Expressions for the intensity

of atomic fluorescence of atoms in atomic fluorescence flame spectrometry are derived by a simple approach. In this approach the atomic fluorescence of atoms at low and high concentrations excited by narrow line and continuous sources is considered, and the approach is general for resonance, stepwise-line, and direct-line fluorescence. A theoretical signal-to-noise expression for atomic fluorescence flame spectrometry is derived. The signal term and each noise term is discussed separately with consideration given to narrow line and continuous sources of excitation with both ac and dc amplifier-readout systems. Limiting detectable atomic concentrations are estimated from theoretically derived expressions for several flame types and actual experimental conditions for several atomic species measured by atomic emission, atomic absorption, and atomic fluorescence flame spectrometry. Dissert. Abstr.

N68-23567# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Materials Lab.
THE DETERMINATION OF CARBONATE IN SODIUM
J. A. J. Walker and E. D. France 1968 12 p refs
(TRG-1635(C)) HMSO: 2s 6d

A method is described for the determination of sodium carbonate in sodium in the range 7–150 ppm with a standard deviation of not greater than 1.5 ppm. The principle of the method involves the removal of sodium by distillation and the conductometric determination of the carbon dioxide evolved after acidification of the distillation residue. It is shown that when a maximum distillation temperature of 350°C is used the decomposition of sodium carbonate in nickel crucibles is negligible. Author

N68-23568 Arizona Univ., Tucson.
PART 1: THERMALLY STABLE POLYMERS: POLYPHENYLPYRAZOLES. PART 2: MECHANISM OF THE PYRODOIN CONDENSATION
James Lambert Bertram (Ph.D. Thesis) 1966 212 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-149

The condensation of m-dihydrazinobenzene (1) with 1,1,2,2-tetracarbonylethanes (2) to produce high molecular weight, thermally stable polymers (3) which contain recurring phenyl and pyrazole units was investigated. For 1,1,2,2-tetraacetylethane (2, R = R' = CH_3), polymers were obtained which gave inherent viscosities as high as 2.81 in formic acid at 30°. These polymers were black infusible solids with a metallic luster and were insoluble in sulfuric acid, dimethylformamide, dimethylsulfoxide, benzene, acetonitrile, methanesulfonic acid, and many other common solvents but dissolved to about 15% in formic acid. These polymers maintained excellent thermal stability at temperatures as high as 450°C. The self-condensation of pyridine-2-aldehyde in acetic acid to pyridoin was investigated. A product study indicated the presence of varying amounts of 2,2'-pyridil due to oxidation of 2,2-pyridoin. Kinetic data were obtained by means of dilatometry on the deuterated and nondeuterated aldehyde. The effects of added acids and bivalent metal ions were also investigated. Dissert. Abstr.

N68-23596 Yale Univ., New Haven, Conn.
A MODEL SYSTEM FOR PHOTOPHOSPHORYLATION
David Barry Knaff (Ph.D. Thesis) 1966 132 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-102

A model system for photophosphorylation has been discovered. Solution of various porphyrins in N,N-dimethylacetamide containing the imidazolium salts of phosphoric acid (P_i) and adenosine-5'-monophosphate (AMP) produces adenosine-5'-triphosphate (ATP) in the light, while no ATP was produced when the solutions were kept in the dark. Imidazole appears to be necessary for the reaction, since no phosphorylation was observed when other bases were substituted for imidazole. Illumination of a solution of porphyrin and dihydrourocanic acid apparently results in the formation of an intramolecular, "high-energy" acyl imidazole, which leads to the formation of ATP when incubated with AMP and P_i in the dark. This reaction suggests itself as a possible model for a primitive photosynthetic system. Dissert. Abstr.

N68-23601 North Carolina Univ., Chapel Hill.
THE SYNTHESIS OF A SERIES OF LIGANDS CONTAINING NITROGEN AND PHOSPHORUS OR ARSENIC DONOR ATOMS WITHIN THE SAME MOIETY. AN INVESTIGATION OF THE DONOR PROPERTIES OF THESE LIGANDS TOWARD CERTAIN TRANSITION METALS
John William Corr (Ph.D. Thesis) 1966 138 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-975

The bidentate ligands 3-diphenylphosphinopropylamine (PA) and 3-diphenylarsinopropylamine (AA) have been prepared. The chelating properties of these new ligands has been investigated with the perchlorate salts of nickel(II), cobalt(II), and copper(II) as well as copper(I) chloride and the hexacarbonyls of chromium, molybdenum, and tungsten. As a consequence of these investigations, the new compounds $[Ni(PA)_2](ClO_4)_2$, $[Cu(PA)_2](ClO_4)_2$, $[Cu(PA)_2](ClO_4)_2 \cdot 2H_2O$, $[Cu(PA)_2][CuCl_2]$, $[Mo(PA)(CO)_4]$, $[Ni(AA)_3](ClO_4)_2$ and $[Mo(AA)(CO)_4]$ have been prepared. All new compounds have been characterized by magnetic moment measurements, conductivity measurements and infrared spectra. Dissert. Abstr.

N68-23604 New York Univ., N. Y.
AN INVESTIGATION OF SUPPRESSION EFFECTS ON POLAROGRAPHIC CURRENTS
Nathan Feldstein 1966 162 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-594

In the present research it has been observed that the addition of small quantities of $AgClO_4$ to alkali perchlorate solutions causes a suppression of the background current at extreme negative potentials. Specifically, the decomposition potential for the background electrolyte is displaced toward more negative potentials as $AgClO_4$ is added. Current-voltage curves were investigated as a function of: (1) suppressor nature and concentration; Ag^+, K^+, Tl^+, Ni^{++}, Zn^{++} and H^+ in the concentration range of 10^{-5} to 10^{-3} M., (2) pH variation, (3) nature and concentration of the background electrolyte, and (4) temperature. It is concluded that the observed suppression effects are best attributed to the presence of a silver hydroxide (oxide) coating on the mercury. This precipitate is formed by the interaction of the incoming Ag^+ ions and the OH^- ions. The OH^- ions are a by-product of the electrochemical reaction accounting for the background current. The presence of this layer at the electrode interface causes changes in the structure of the double layer and specifically makes the potential ϕ_2 more positive. Furthermore, the presence of this coating acts as a barrier to the mass transport of electroactive species. Dissert. Abstr.

N68-23605 North Carolina Univ., Chapel Hill.
NUCLEAR SPIN-LATTICE RELAXATION IN ALKALI HALIDES AT LOW TEMPERATURES
Charles Edwin Tarr (Ph.D. Thesis) 1966 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-1057

The longitudinal relaxation time T_1 was measured for the halide resonances in sodium bromide, lithium bromide, sodium iodide, and rubidium iodide single crystals in the temperature range 15–77.3°K. The gross temperature dependence of T_1 was found to agree well with the rigid ion theory of Van Kranendonk, and was thus found to be primarily attributable to quadrupolar relaxation

mechanisms. The data are compared to the Van Kranendonk theory for several values of the appropriate characteristic temperature. A departure to anomalously long values of T_1 was noted in the range ≈30–60°K. This departure is attributed to structure in the phonon spectra. This comparison also reveals some dependence of T_1 on the optical phonons. Data were also taken at room temperature which indicated that optical phonons are important to the relaxation process at high temperatures. Tables of functions computed in the course of this work are included in an appendix. Dissert. Abstr.

N68-23820 IIT Research Inst., Chicago, Ill.
BOND STRENGTHS AND ENERGIES FOR DIATOMIC MOLECULES AND SUBSTITUTED METHANES
Augustus Isaac Dhar (Ph.D. Thesis) 1966 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-353

If we know the spectroscopic constants ω_e, $\omega_e x_e$, and $\omega_e y_e$, the equilibrium internuclear distance r_e, the bond energy W_{Do}, and the reduced mass μ of a diatomic molecule, we can calculate the band origin σ of the 1–0 bands; the force constants $f_\beta = 4\pi^2 c^2 \omega_e \mu$ and $f_\sigma = 4\pi^2 c^2 \sigma^2 \mu$, where c is the velocity of light in vacuum; the constant $C_f = f_\sigma / f_\sigma / \omega_e / \sigma^2$; the zero-point energy W_{oo}; the equilibrium dissociation energy W_{De}; the constant $C_w = W_{De}/W_{Do}$; the bond strength S; the potential energy U_i at the point of inversion i in the Morse potential energy curve U at the internuclear separation $r = R_i$; the values of $R_i - r_e$ and $r_e - r_i$ where r_i is the other point of energy U_i; the "distance of asymmetry" A in the curve for U; and the constant a in the Morse function. Knowing the values of W_{De}, r_e, and a the Morse potential energy function U is fully determined for a diatomic molecule. Such calculations were done for 49 diatomic molecules which were classified into the bond types B–A, B–B, B–C, B–D, and B–E. Dissert. Abstr.

N68-23845*# California Univ., Berkeley. Space Sciences Lab.
CHEMICAL EVOLUTION
Melvin Calvin *In its* Ann. Conf. of Episcopal Cathedral Deans 10 Apr. 1967 p 14–24 (See N68-23643 13-34)

The field of chemical evolution searches for evidence from that evolutionary period in which the chemical constituents of the earth were transformed into chemicals from which life developed. The search is conducted in rocks of various geological ages. Sections of two of these, the Green River Shale whose age is some 60 million years and the Soudan Shale whose age is 2.7 billion years, are shown and discussed. The molecular sieve was used to extract organic materials from these rocks and separate them into classes of compounds. An analysis of the fractionated extracts from these rocks points to a biological origin of these compounds. This places the beginning of the development of life on earth into an early phase of the earth and also changes the time scale of the rate of chemical evolution if the earth is in fact 5 billion years old. Many of these organic compounds may have been present in the cosmic dust which gave rise to the earth. To test this hypothesis analyses should be made of earth material older than 2.7 years, meteorites, and lunar material for organic constituents. R.N.A.

N68-23846*# California Univ., Berkeley. Space Sciences Lab.
MOLECULAR BIOLOGY AND GENETICS
T. H. Jukes *In its* Ann. Conf. of Episcopal Cathedral Deans 10 Apr. 1967 p 25–39 (See N68-23643 13-34)

Using the analogy of language, this article explains in detail the structure and function of the DNA molecule in transmitting the genetic message from one generation to another. Each long sequence of the genetic message consists of a permutation, of a few different units, and this is continued for millions and millions of letters selected from the four variables of the DNA alphabet. The manner in which the DNA molecule reproduces itself and the three types of RNA molecules and their functions in manufacturing living organisms from instructions in the original DNA are described. It is also shown how the RNA molecule picks up amino acids to form proteins and the genetic code, how the code is translated, and what happens when it is translated. Mutations of the DNA molecule and some examples are discussed. A comparison is made of the percentage differences in the amino acids of the cytochrome protein of different species and it is shown how these differences can be used to construct a phylogenetic tree showing all the descent of all living species. R.N.A.

N68-23873 Emory Univ., Atlanta, Ga.
ANALYSIS AND INSTRUMENTATION IN NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY
Ralph Elliott Mayo (Ph.D. Thesis) 1966 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-769

The value of using both the normal proton and C^{13}–H satellite patterns in difficult NMR analyses is shown. This method is shown to produce unique NMR parameters even where intensity measurements and spectra at two different field strengths have failed to do so. A unique set of NMR parameters for acrylonitrile, γ-pyrone and furan has been found when the parameters are required to predict both the normal proton and C^{13}–H satellite patterns. A complete NMR analysis of all four vinyl halides including the C^{13}–H satellite patterns is reported. A complete NMR analysis of the AA'BB'C spectrum of biphenyl is reported. The construction and use of a hetero-nuclear decoupler on the Varian Model A-60 Spectrometer is described. Two methods of improving the spectrometer signal-to-noise ratio are described: (1) the use of an integrator technique, and (2) the use of automatic data handling with digital computer noise averaging. Dissert. Abstr.

N68-23882 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
STUDY OF THE ANiON EXCHANGE AFFINITY AND CHROMATOGRAPHIC SEPARATION OF THE RARE EARTH COMPLEXES WITH TRANS-1,2-DIAMINOCYCLOHEXANE-N, N'-TETRAACETIC ACID [BADANIE ANIONOWYMIENNEGO POWINOWACTWA I CHROMATOGRAFICZNEGO ROZDZIELANIA KOMPLEKSOW COMPLEKSOW ZIEM RZADKICH Z KWASEM TRANS-1,2 DWUAMINOCYKLOHEKSANO N,N' CZTEROCTOWYM]
Ludmila Wodkiewicz and Rajmund Dybczynski 1967 23 p refs Transl. into ENGLISH from Polish
(IBJ-860/VIII/C) CFSTI: $3.00

Anion exchange behaviour of the rare earth elements in the system: Dowex 1×4 $[H_2Z^{2-}]$—aqueous solution of disodium salt of trans-1, 2-diaminocyclohexane-N, N'-tetraacetic acid has been studied. All the lanthanides, Sc and Y form complexes of the LnZ^- type. Ion exchange affinity in the lanthanide series increases in a regular manner from lanthanum to promethium and then decreases with further increase of atomic number. Apparent atomic numbers of Sc and Y in this system are $64^{1/2}$ and $67^{1/2}$ respectively. Separation factors of adjacent lanthanides are substantially smaller than corresponding values for Dowex 1×4 $[H_2Y^{2-}]$—Na_2H_2Y aq. system (when Y^{4-} stands for EDTA anion). Some separation however can still be achieved, heights equivalent to a theoretical plate are greater than in the corresponding EDTA system, indicating that ion exchange kinetics in DCTA system is less favorable. Author

N68-23887# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Chemistry.
ELECTROCHEMICAL PROCESSES ON NICKEL OXIDE
Daniel Yohe, Ernest Yeager, Robert Greef, and Alan Riga 1 Jul. 1967 189 p refs
(Contract Nonr-1439(09))
(TR-3; AD-667607)

An investigation was made of the electrochemical behavior of single crystal lithiated nickel oxide. Studies of the current-potential relationships for various redox couples on these electrodes were emphasized in order to gain information concerning the influence of the semiconducting properties of the NiO electrode on charge transfer across the electrode-solution interface. Additional work was done on the reduction of oxygen in basic solution as an example of a reaction where specific catalytic properties of the NiO beyond just the carrier concentration should be important. These kinetic measurements were complemented with voltammetry and a.c. impedance studies of the intrinsic electrochemical properties of the single crystal oxide. Author (TAB)

N68-23696# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.

THE DETERMINATION OF PLUTONIUM ALPHA ACTIVITY IN URINE BY SURFACE ADSORPTION AND ION EXCHANGE

J. D. Eakins Dec. 1967 13 p refs

(AERE-R-5637) HMSO: 2s 6d

This report describes work carried out to select and evaluate an ion exchange procedure which, in conjunction with the surface adsorption method for determining gross alpha activity in urine, gives a highly specific procedure for plutonium alpha activity. The chosen procedure is examined with reference to decontamination from other actinide elements, recovery of plutonium and the source of background activity. The decontamination factors for other actinide elements are in excess of 100 in all cases. The overall recovery of plutonium is 89 ±4% and the background activity obtained from the urine of unexposed people is 0.015 ±0.005 pCi/1500 ml. The procedure is very suitable for analyzing large numbers of samples and requires little operator expertise. The use of the same basic procedure for gross alpha activity and plutonium has advantages both in economy of materials and ease of staff training. Author

N68-23702# General Electric Co., Schenectady, N. Y. Metallurgy and Ceramics Lab.

THE STRENGTH OF NONSTOICHIOMETRIC OXIDES

Technical Information Series

J. S. Nadeau Jun. 1967 13 p refs

(Rept.-67-C-243)

The reduction of high temperature strength by nonstoichiometry has been previously studied in $Fe_{1-x}O$, TiO_{2-x}, and UO_{2+x}. These studies have indicated that the softening is probably related to the enhancement of diffusion. However, the nature of the high temperature deformation process is not understood. The available information on defect structures, diffusion and high temperature strength of the three oxides named above are reviewed in this report and are compared with a variety of theoretical models to determine whether the softening by nonstoichiometry has a common physical origin. It is concluded that none of the data are as yet sufficiently complete to permit a clear understanding of the phenomenon. Author

N68-23730 Yale Univ., New Haven, Conn.

THE FAR INFRARED SPECTRA OF RARE EARTH ETHYLSULPHATES

John Campbell Hill (Ph.D. Thesis) 1966 97 p

Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-84

A far infrared interferometric spectrometer has been used to make the first direct observation of transitions between the Stark split ground J-manifolds of rare earth ions in ethylsulphate crystals. With the additional use of a superconducting magnet it has been possible to also observe the Zeeman splitting of the Stark components. The description of both the Stark and Zeeman splittings in terms of crystal field theory has been considered, and the data obtained here has proved sufficient for making an accurate evaluation of the parameters contained in the theory. The intensities of the observed transitions have been investigated, and it has been found that they are primarily magnetic dipole transitions. However, significant deviations between calculation and observation occurred for both the splittings and line intensities. A hypothesis has been developed by which both kinds of discrepancies are attributed to interaction between the rare earth ion electronic states and the phonons or lattice waves in the ethylsulphate crystals. Dissert. Abstr.

N68-23736# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.

THE PREPARATION OF ^{153}EUROPIUM(2) OXIDE

B. M. Maude and K. L. Wilkinson Jan. 1968 19 p refs

(AERE-R-5670)

Various methods for the preparation of pure europium(2) oxide from europium(3) oxide, using natural europium, have been studied. The method chosen for the final europium isotope preparation was carbon reduction of the ^{153}europium(3) oxide. Author

N68-23746 Florida State Univ., Tallahassee.

IONIZATION CURRENT MEASUREMENTS IN MIXTURES OF ORGANIC VAPORS

Linda Marie Hunter (Ph.D. Thesis) 1966 128 p

Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-337

Ionization currents have been measured in mixtures of organic vapors, such as the cyclohexane–benzene system, using a heated ionization chamber. Analysis of the products from the irradiation of these types of mixtures have indicated, in previous experiments, that physical and chemical interactions are occurring between the components. In this research, the behavior of the ionization currents in the hydrocarbons was found to deviate from the behavior of that of the molecular gas, nitrogen, and to vary with pressure. The theory of Boag for a parallel plate ionization chamber adequately treated the data from those cases in which negative ionic species are not formed in the vapor to determine a current at saturation conditions. Dissert. Abstr.

N68-23777 California Univ., Los Angeles.

NMR AND KINETIC STUDIES OF PLATINUM(2) COMPLEXES

Patricia Aileen Cronin (Ph.D. Thesis) 1966 246 p

Available from Univ. Microfilms: HC $11.25/MF $3.20 Order No. 67-442

Nuclear magnetic resonance techniques were applied to the elucidation of structural features as well as following rate processes in solution. The sulfur atom in compounds of the type bis(dialkylsulfide)dichloroplatinum(2) was shown to have a pyramidal configuration unstable to inversion. Evidence is presented for inversion resulting from the platinum atom flipping between the two sulfur orbitals containing lone electron pairs. The rate of chloride displacement in diaminedichloroplatinum(2) complexes was followed conductrimetrically. The displacing agents, ethylenediamine and dithiooxamide, gave pseudo first order rates (nucleophile in excess); thiourea gave consecutive first order kinetics. Since the conductivity measurements corresponding to zero reaction time and infinite reaction time can only be estimated, computer programs were written to analyze the data. The programs are based on a Taylor's expansion of the nonlinear equations; the unknowns are successively approximated until they have a least squares consistency with the data. Dissert. Abstr.

N68-23820# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRON MICROSCOPE STUDY OF AGGREGATION OF SUSPENSIONS OF LIMONITE AND FERRIMOLYBDITE IN CONNECTION WITH THEIR FLOTABILITY [ELEKTRONNOM-IKROSKOPICHESKOYE IZUCHENIYE AGREGIROVANNOSTI SUSPENZIY LIMONITA I FERRIMOLIBDITA V SVYAZI S IKH FLOTIRUYEMOST'YU]

S. A. Parshenkov, S. F. Kuz'kin, G. A. Kahn, and N. F. Panteleyeva *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 37–40 refs (See N68-23814 13-15)

A brief report of the connection between the aggregate state of minerals and their flotability based on the authors' use of electron microscopy to investigate suspensions of limonite and ferrimolybdite is given. Photographs of precipitates were obtained and described. Reagents used were oleic acid in one instance, and an emulsion of oleic acid, liquid glass, and iron sulfate in a soda medium in the second. Author

N68-23821# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF THE METHOD OF ANHYDROUS TITRATION FOR DETERMINATION OF FATTY ACIDS FIXED ON THE SURFACE OF MINERALS [PRIMENENIYE METODA NEVODNOGO TITROVANIYA DLYA OPREDELEN-IYA ZHIRNYKH KISLOT, ZAKREPIVSHIKHSYA NA POVER-KHNOSTI MINERALOV]

A. M. Komlev and S. I. Pol'kin *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 41–47 refs (See N68-23814 13-15)

To determine the adsorption of tall oil and oleic acid on the surface of minerals (olivine and ludwigite), the solution of desorbed tall oil and oleic acid is titrated potentiometrically with alkaline KOH or $Ca(OH)_2$. Adsorbed oleic acid and tall oil are determined separately in the solution obtained after the reagents are desorbed from the surface of the mineral selectively. They are titrated potentiometrically with alkaline $Ca(OH)_2$. The amount of reagent that penetrated into the crystal lattice of the mineral is determined gravimetrically in a HCl solution of powdered minerals. Author

N68-23822# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELECTION OF OPTIMUM PARAMETERS DURING RADIOMETRIC DETERMINATION OF LEAD IN CONCENTRATION PRODUCTS [VYBOR OPTIMAL'NYKH PARAMETROV PRI RADIOMETRICHESKOM OPREDELENII SVINTSA V PRODUKTAKH OBOGASHCHENIYA]

L. M. Velyus and P. D. Korzh *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 49–59 refs (See N68-23814 13-15)

The optimum parameters for highest concentration sensitivity to the absorption of β-rays from Tl^{204} by a sample containing Pb can be evaluated from the parameters S and Σ where S is concentration sensitivity ($S = (230/\Delta C) \log N_{max}/N_{min}$; Δc is the range of variation in Pb concentration, N_{max} and N_{min} are recording rates) and Σ is the mean value of the relative error, $\delta C100/C$, where δ is mean error of recording; C is the Pb concentration. The concentration sensitivity and the reproducibility depend on: distance between the emitting source and the receiver; thickness of the translucent sample layer; diameter of the sample cell; size of the sample; material and thickness of the walls and bottom of the sample cell; and activity of the emission source. The optimum geometric parameters differ for different products. The wall thickness of the film holder and the activity of the source should be adjusted to the sample. Author

N68-23824# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPARATIVE INVESTIGATION OF OXIDATION RATES OF COPPER AND ITS REDUCTION FROM OXIDES BY THE METHOD OF ELECTRICAL CONDUCTIVITY [SRAYNITEL' NOYE ISSLEDOVANIYE SKOROSTEY OKISLENIYA MEDI I VOSSTANOVLENIYA YEYE IZ OKISLOV METODOM ELEKTRO-PROVODNOSTI]

Ye. S. Vorontsov and A. V. Yermakov *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 69–77 refs (See N68-23814 13-15)

Wires 100 cm. long and 0.19 mm. in diameter, with resistivity $\approx$2–3 times that of the feed wires, were adapted for investigation. The wire was wound around a small corundum pipe and set into the isothermal zone of the silica tube of an electric heated furnace. The wire was subjected to oxidation with O and subsequent reduction with H or CO with the rate of gas flor 130 ml./min. The consumption of the gas was computed by rheometer. Readings for R_T were taken every 5 minutes. The advantage of this method is the possibility of a comparative study of the oxidation and reduction of metals in identical physical and geometric conditions. The time of the experiment at 500°, 600°, or 700° was as long as was required to increase the resistivity 1000 times over the initial. The reduction process is faster than the oxidation. After the oxidation-reduction cycle, the volume of the wire increase indicated the porosity of the reduced metal. Further refinement of this method will afford precise information on the kinetics of the oxidation-reduction processes. Author

N68-23827# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE SEPARATION OF NICKEL FROM COBALT IN AMMONIUM SOLUTIONS [K VOPROSU OB OTDELENII NIKELA OT KOBAL'TA V AMMIACHNYKH RASTVORAKH]

V. I. Rybnikov and V. I. Smirnov *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 97–103 refs (See N68-23814 13-15)

A practical possibility is shown for the separation of Ni and Co in the ammoniacal solution from autoclave leaching. The separation is based on the different stabilities of Ni and Co ammoniates to the action of H_2–SO_4. To decompose the Ni ammonium complex and to obtain the most complete separation of Ni, the solution of ammoniates is brought to pH 2–3 by the addition of H_2SO_4 (1:1). The Ni (96.6%) is precipitated as $NiSO_4 \cdot (NH_4)_2 \cdot SO_4 \cdot 6H_2O$, slightly contaminated by adsorption of Co (0.05–0.1%). The mother liquor contains $\leq$97.5% of the Co and $(NH_4)_2SO_4$; the rest of the Co is in the wash water ($\leq$14%). Author

N68-23830# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ISOBARIC POTENTIALS OF OXIDATION OF ANTIMONY AND TIN DURING ALKALINE REFINING OF LEAD [IZOBARNYYE POTENTSIALY OKISLENIYA SUR'MY I OLOVA PRI SHCHELOCHNOM RAFINIROVANII SVINTSA]

V. S. Lovchikov *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 115–121 refs (See N68-23814 13-15)

The isobar potentials of Sb and Sn oxidation decrease irregularly with impurities concentration in the Pb. The isobars of oxidation potentials for Sb, Sn + PbO_2, and Na_2PbO_2 decrease 9.0–47.9% for Sb and 15.6–21.5% for Sn if the amount of impurities is 1 to 0.1 g. atom in 1 g. atom on the melt. NaOH promotes the formation of antimonites and stannites with large negative values for isobar potentials, therefore, the presence of NaOH in the alkaline melt during refining lowers the residual concentration of Sb and Sn in Pb. The limits of thermodynamic refining of Pb from Sn and Sb approach 4.66×10^{-19} and 8.3×10^{-18} wt. %, respectively. If 1 g. atom of the melt contains

1–0.1 g. atom impurities the isobar potentials of Sn oxidation diminish faster than the one for the oxidation of Sb. This fact can affect the Sb and Sn oxidation with Na_2PbO_2. Author

N68-23832# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF THE SILICON RATIO OF THE INITIAL SOLUTION, THE DEGREE OF DECOMPOSITION AND THE SEED CHARGE ON THE QUALITY OF ALUMINUM HYDROXIDE DURING CARBONIZATION [VLIYANIYE KREMNEVOGO MODULYA ISKHODNOGO RASTVORA, GLUBINY RAZLOZHENIYA I ZATRAVKI NA KACHESTVO GIDROOKISI ALYUMINIYA PRI KARBONIZATSII]
A. I. Layner, M. A. Kolenkov, and L. U. Kotiyeva *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 129–135 refs (See N68-23814 13-15)

This article describes laboratory experiments devoted to showing that the quality of aluminum hydroxide changes in the course of carbonization with respect to the silicon ratio of the initial solution and the quantity and quality of the seed charge. The purer the initial solution in terms of silica content, the more aluminum hydroxide corresponding to the highest grades of alumina separated during carbonization. Carbonization of desiliconized aluminate solutions in the presence of a seed charge of freshly-precipicated aluminum hydroxide provides alumina considerably purer in terms of silica content than under the same conditions without a seed charge or with a small quantity of charge. Best results are obtained at a seed charge ratio equal to unity and with the impurity of silica in the seed charge no greater than that in the given grade of alumina. Author

N68-23833# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF INTERACTION CADMIUM OXIDE WITH DIFFERENT CHLORINATING AGENTS [ISSLEDOVANIYE VZAIMODEYSTVIYA OKISI KADMIYA S RAZLICHNYMI KHLORIRUYUSHCHIMI AGENTAMI]
A. N. Ketov, V. V. Pechkovskiy, and L. P. Kostin *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 137–142 refs (See N68-23814 13-15)

Thermographic investigation of CdO chlorination with different chlorinating agents indicated that chlorinating power of agents gradually declines in the order HCl, (Cl_2 + CO), $COCl_2$, Cl, CCl_4. Chlorination of CdO with the mixture Cl + CO results first in reduction of the oxide to metallic Cd with the resultant product being $CdCl_2$. The starting temperature for chlorination of CdO with 100% Cl and with a CO mixture is practically the same. During chlorination with HCl a hydrate $CdCl_2H_2O$ is formed in the temperature range up to 136°. At higher temperatures anhydrous $CdCl_2$ and in the temperature range 355–530°C CdCl probably exist. Author

N68-23834# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF REACTION OF THE CHLORIDE AND BROMIDE OF ANTIMONY WITH THE CORRESPONDING HALIDES OF ALKALI ELEMENTS CLOSE IN TERMS OF PROPERTIES [ISSLEDOVANIYE VZAIMODEYSTVIYA KHLORIDA I BROMIDA SUR'MY S SOOTVETSTVUYUSHCHIMI GALOGENIDAMI BLIZKIKH PO SVOYSTVAM SCHELOCHNYKH ELEMENTOV]
V. Ye. Plyushchev, S. B. Stepina, G. V. Zimina, and V. G. Zhilyakov *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 143–148 refs (See N68-23814 13-15)

The thermal investigation of binary systems RbCl–$SbCl_3$, CsCl–$SbCl_3$, KBr–$SbBr_3$, RbBr–$SbBr_3$, and CsBr–$SbBr_3$ indicated that the system RbCl–$SbCl_3$ is characterized by the formation of $RbCl_3$·$SbCl_3$ and 3RbCl–$SbCl_3$, which melt incongruently at 128 and 450°, respectively. The system CsCl–$SbCl_3$ possesses two compounds 3CsCl·2$SbCl_3$ and 3CsCl–$SbCl_3$, which melt congruently at 540 and 550°. All systems formed by $SbBr_3$ with K, Rb, and Cs bromides have a well developed eutectic with composition close to pure $SbBr_3$ with the corresponding temperature 96–98°; the systems KBr–$SbBr_3$ and RbBr–$SbBr_3$ are characterized by the formation of an incongruently melting compound with the mole ratio of components 3:2 and 3:1 (KBr:$SbBr_3$) and 4:1 (RbBr:$SbBr_3$). In the system CsBr–$SbBr_3$ there is a congruently melting 625° compound 3CsBr·2$SbBr_3$ which has a polymorphic transformation at 530°. Author

N68-23835# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF PHASE DIAGRAM OF THE SYSTEM Rb SUB 2 O–V SUB 2 O SUB 5 [ISSLEDOVANIYE DIAGRAMMY SOSTOYANIYA SISTEMY Rb SUB 2 O–V SUB 2 O SUB 5]
I. N. Belyayev and T. G. Golovanova *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 149–152 refs (See N68-23814 13-15)

The diagram plotted from heating curves disclosed the presence of five components: $Rb_2O·3V_2O_5$ (Rb hexavanadate), red crystals, m. 508°; $Rb_2O·V_2O_5$ (Rb metavanadate), white readily disintegrating crystals, m. 560° and phase transformation at 518°; $16Rb_2O·9V_2O_5$ identical to K and Cs vandate, melts with decomposition at 736° and undergoes phase transformation at 662°; $2Rb_2O·V_2O_5$ (Rb pyrovanadate), m. 930° and phase transformation at 706°; and $3Rb_2O·V_2O_5$ (Rb orthovanadate), m. 1200° (determined by extrapolation), three eutectics and one peritectic (liquid + $2Rb_2O·V_2O_5 \rightleftharpoons 16Rb_2O·9V_2O_5$ + liquid) melts at 736° and 62% Rb_2O. Author

N68-23838# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUESTION OF DEPOSITION OF TANTALUM FROM THE VAPOR-GAS PHASE [K VOPROSU OSAZHDENIYA TANTALA IZ PARO-GAZOVOY FAZY]
Ya. M. Polyakov and G. Z. Zamesova *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 167–170 ref (See N68-23814 13-15)

A series of experiments with vapor deposition of tantalum were performed in order to determine the basic conditions of the process. Tantalum pentachloride was evaporated into a stream of dry hydrogen and reduced to tantalum which condensed the outside surface of a nickel tube maintained at 650–1330°C. The thickness of deposits obtained varied with the temperature of the tube, and the deposition rates varied from 50 μ deposited in 40 min at 650°C to 250 μ deposited in 20 min at 1170°C. Deposits obtained at 650°C consisting only of tantalum were brittle and could be easily removed from the substrate. Deposits obtained at 800°C also contained tantalum hydrides, and those obtained at 900°C and above contained tantalum hydrides and a tantalum–nickel solid solution. The latter deposit adhered tightly to the substrate, forming a diffusion zone. Vacuum outgassing of deposits at 1800°C eliminated all of the gases and the nickel. The degassed deposits contained 0.409–0.715% impurities, including 0.2–0.5% niobium. Author

N68-23850# Nebraska Univ., Lincoln. Dept. of Chemistry.
HALOGEN ATOM REACTIONS ACTIVATED BY RADIATIVE NEUTRON CAPTURE AND Br^{82m} AND I^{130m} ISOMERIC TRANSITION Progress Report, Feb. 1967–Feb. 1968
Feb. 1968 128 p refs
(Contract AT(11-1)-1617)
(COO-1617-10; PR-2) CFSTI: HC $3.00/MF $0.65

Reactions of bromine and iodine were studied in gaseous, liquid, and solid hydrocarbon systems and the polyhalomethanes.

In all these reaction systems the hot atom was not initially bound to the target molecule. Facilities and instrumentation are described. NSA

N68-23853# Calvin Coll., Grand Rapids, Mich. Dept. of Chemistry.
SILVER OXIDE ELECTRODE PROCESSES Final Report
Thedford P. Dirkse 31 Mar. 1968 19 p refs
(Contract Nonr-1682(02))
(TR-7; AD-667586)

A cyclic voltammetric study was made of the silver electrode in KOH solutions at room temperature. The presence of carbonate ion has no noticeable effect on the current. The results obtained can quite readily be interpreted in terms of Ag, Ag2O, and AgO as the only solid species containing silver. The silver electrode was also subjected to short constant-voltage pulses. However, the results obtained do not allow one to infer any simple electrode reaction mechanism. Author (TAB)

N68-23877# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
ADDITION COMPOUNDS OF HAFNIUM AND ZIRCONIUM TETRACHLORIDE WITH ORGANIC LIGANDS
W. M. Graven and R. V. Peterson Feb. 1968 24 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-30)-1; SAMSO-TR-68-135; AD-667785)

Addition compounds of HfCl4 and ZrCl4 with eight organic ligands were prepared and analyzed. Infrared spectral and thermal decomposition measurements demonstrated the similarity of properties between addition compounds of these two metal tetrahalides. Author (TAB)

N68-23897 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
STATIC AND DYNAMIC EXTRACTION OF SOME METALS IN THE SYSTEMS TETRABUTYLHYPOPHOSPHATE-TETRABUTYLPYROPHOSPHATE (1:1) AND TETRABUTYLPYROPHOSPHATE/MINERAL ACIDS [EKSTRAKCJA STATYCZNA I DYNAMICZNA NIEKTORYCH METALI W UKLADACH CZTEROBUTYLOHIPOFOSFORAN-CZTEROBUTYLOPIROFOSFORAN (1:1) ORAZ CZTEROBUTYLOPIROFOSFORAN/KWASY MINERALNE]
Jan Mikulski 1968 83 p refs In POLISH; ENGLISH summary
(INP-591/C) CFSTI: $3.00

The distribution coefficients of the following ions: Zr^{+4}, Hf^{+4}, Th^{+4}, Nb^{+5}, Ta^{+5}, Pa^{+5}, $U^{+4,+6}$, $Np^{+4,+6}$ and $Pu^{+4,+6}$ were determined using TBHP–TBPP (1:1) and TBPP in the static extraction. Using the dynamic extraction in the system TBHP–TBPP (1:1)–HNO_3 some rare earths and transuranium elements were separated. The distribution coefficients of californium, fermium, and mendelevium were determined from the chromatographic data. Author

N68-23906# New York Univ., N. Y. Dept. of Chemistry.
QUANTUM-MECHANICAL CALCULATIONS ON THE NO + O REACTION Final Report, 1 Jan. 1966–31 Dec. 1967
Louis Burnelle 5 Feb. 1968 43 p refs
(Contract AF 19(628)-5729)
(AFCRL-TR-68-0137; AD-667516)

In order to analyze the mechanisms involved in the nitric oxide-atomic oxygen reaction, the potential energy surfaces associated with the various electronic states of the NO + O system have been investigated. In a first approach, the extended Huckel method was applied to NO2 and its ions for a series of bond angles. This provided a reasonable description of the electronic structure of the ground state of the species. At a later stage the nonempirical self-consistent-field method was applied to the ground state and to a series of excited states of NO2. Potential energy curves were obtained as a function of the bond angle. From the correlations between the electronic states of the bent molecule and those of the linear system, qualitative indications were then obtained concerning the potential energy surfaces of the NO + O system. Author (TAB)

N68-23915# Los Angeles State Coll., Calif. Dept. of Chemistry.
A VARIABLE-TEMPERATURE NUCLEAR MAGNETIC RESONANCE STUDY OF COMPLEXES OF BORANE AND BORON TRIHALIDES WITH ACETONE, DIETHYL ETHER, DIMETHYL ETHER, N,N-DIMETHYLFORMAMIDE, METHANOL, AND TETRAHYDROFURAN
Anthony Fratiello, Thomas P. Onak, and Ronald E. Schuster Mar. 1968 39 p refs Submitted for publication
(Contract Nonr-3364(00))
(TR-18; AD-667454)

A proton and boron-11 chemical shift and coordination number study of complexes of diborane and the boron trihalides with dimethyl ether, diethyl ether, methanol, tetrahydrofuran, and, to a small extent, acetone and N,N-dimethylformamide has been completed. At low temperatures, separate proton resonance signals are observed for bulk solvent and solvent molecules complexed with the boron species. Coordination numbers were measured by the direct integration of the separate signals. The chemical shift separations for bulk and complexed solvent signals decreased in the order BBr3 > BCl3 > BF3 > BH3. An attempt is made to relate these separations to the coordinating abilities of the boron halides. The proton chemical shift data of the bases were correlated with some diborane 11B and 1H nuclear magnetic resonance results to obtain information concerning the species present in the ether-diborane solution. Author (TAB)

N68-23919# General Electric Co., Schenectady, N. Y.
SURFACE INTERACTIONS OF IODINE VAPOR WITH TUNGSTEN
Bruce McCarroll Aug. 1967 6 p refs
(Rept.-67-C-338)

The interactions of iodine vapor with a clean tungsten surface were studied by first absorbing the iodine on the tungsten ribbon and then thermally desorbing the adlayer. The composition of the desorption products was determined with a time of flight mass spectrometer. No evidence is found for the formation of surface compounds. Only iodine atoms and, at higher coverages, iodine molecules populate the surface. Both desorptions are first order, and the most tightly bound atom state has a desorption energy of ≈80 kcal. A second, lower energy atom state is populated at higher coverages. An estimate of the iodine molecule desorption energy gives ≈30 kcal. Author

N68-23950# Naval Research Lab., Washington, D. C.
OXIDATION OF HYDROGEN ON A PASSIVE PLATINUM ELECTRODE
Sigmund Schuldiner 27 Feb. 1968 10 p refs
(NRL-6659; AD-667716)

Under potentiostatic, steady-state conditions and at anodic potentials above 0.7 V (NHE), the rate of oxidation of molecular hydrogen decreases at a high-activity Pt electrode in 1M H2SO4. It is shown that this decrease is not owing to the formation of oxygen species on the electrode surface. It is believed that this passive behavior of Pt is due to anion adsorption - at least between 0.7 and 1.2 V. Depending on potential and previous potential sequence, passivity in this region is evidently sensitive to the amount of sulfate ion adsorbed, its heat of adsorption, and the presence of dermasorbed oxygen. At higher potentials both sorbed oxygen species and sulfate ion may be present and may contribute

to the passivity. In the 0.7 to 1.2 V passive region, hydrogen oxidation is electrochemical. There is no significant chemical oxidation via an oxygen intermediate. Author (TAB)

N68-24030 Tennessee Univ., Knoxville.
OXIDATION OF HYDROGEN AND CARBON MONOXIDE IN A HELIUM STREAM BY COPPER OXIDE. ANALYSIS OF COMBINED FILM AND PORE DIFFUSION WITH RAPID IRREVERSIBLE REACTION FOR TWO COMPONENTS IN A FIXED BED PROCESS
Charles David Scott (Ph.D. Thesis) 1966 311 p
Available from Univ. Microfilms: HC $14.20/MF $3.00 Order No. 67-1376

The reaction of hydrogen and carbon monoxide as contaminants from a stream of helium with fixed beds of copper oxide pellets was investigated in tests with both differential and deep beds and with both a single reacting-species and two reacting species. Differential-bed tests established transport properties of the contaminants within the porous solids, and deep beds were evaluated by considering the effluent concentration history of the contaminants. The ranges of experimental conditions were: temperature 400°–600°C; pressure 10.2–30.0 atmospheres; mass flow rate of gas 0.0058–0.050 g/cm^2-sec; and inlet concentration of reacting species 0.0008–1.21%. The results indicate that the reaction system can be represented by two rate-limiting steps: (1) external diffusion of the contaminant gas through a stagnant gas film surrounding the copper oxide pellet; and (2) molecular diffusion of the contaminant through the pores in the porous solid to the reaction site. Differential equations were developed to describe the mathematical model of the system, and the mathematical solution was extended to the generalized case. Finite-difference solutions of the differential equations were made, and computer codes were written and used for these solutions. Dissert. Abstr.

N68-24053# Aerospace Corp., El Segundo, Calif. Lab. Operations.
KINETICS OF HYDROGEN HALIDES IN SHOCK WAVES. THE REACTIONS CL+HCL AND CL+CL$_2$, JULY 1967–JANUARY 1968
Theodore A. Jacobs, Robert R. Giedt, and Norman Cohen Jan. 1968 23 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-20)-8; SAMSO-TR-68-117; AD-667560)

The decomposition of HCl via the chlorine exchange reaction Cl + HCl = Cl2 + H was studied in the shock tube. The rate constant deduced for this reaction over the temperature range 3500 - 5200K was found to be consistent with the low temperature value of Klein and Wolfsberg. The study also yielded the efficiency of Cl atoms in decomposing Cl2. Compared to Ar, Cl was found to be ten times more efficient. Author (TAB)

N68-24058# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LENINGRAD. UNIVERSITY. HERALD. PHYSICS AND CHEMISTRY SERIES [VESTNIK LENINGRADSKOGO UNIVERSITETA. SERIYA FIZIKI I KHIMII]
9 May 1967 197 p refs Transl. into ENGLISH from Russian
(FTD-MT-64-358; AD-666727)

A collection of Soviet articles is presented pertaining to nuclear and solid state physics, geophysics, thermodynamic properties of materials, atmospheric chemistry, polymer chemistry, and thermochemistry. For individual titles, see N68-24058 through N68-24084.

N68-24064# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPENDENCE OF ANGLES OF ORIENTATION IN DYNAMIC DOUBLE REFRACTION ON THE VELOCITY GRADIENT. CONSIDERATION OF ANISOTROPY OF A HYDRODYNAMIC INTERACTION [ZAVISIMOST'UGLOV ORIYENTATSII V DINAMICHESKOM DVOYNOM LUCHEPRELOMLENII OT GRADIYENTA SKOROSTI. UCHET ANIZOTROPII GIDRODINAMICHESKOGO VZAIMODEYSTVIYA]
V. P. Budtov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 71–80 refs (See N68-23058 13-06)

The orientation angle of polymethyl methacrylate (PMMA) solutions in tetrabromethane for six fractionated and unfractionated specimens has been studied in a velocity gradient range (shear rate) 4 to 2000 sec^{-1}. The velocity of the solvent η_0 varied from 6 to 15.6 cp. In the region of small velocity gradients it is shown that tan $2\phi/g$ is a function of g^2, where $\phi = \pi/4 - \chi$ (χ—angle between macromolecule orientation direction and flow velocity) and g—shear rate. A general parameter $g\tau$ (τ—initial slope of extinction angle) is found to correlate the experimental data successfully. Author

N68-24068# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON POLYANIONS IN SOLUTIONS [O POLIANIONAKH V RASTVORAKH]
L. G. Sillen *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 101–113 refs (See N68-24058 13-06)

A critical survey is presented on the polymerization of anion-complexes in aqueous solutions. Attention is drawn to the systems of polyborates, wolframates, vanadates, molybdates and chromates. A theoretical method using computer technique has given good results based on experimental measurements. The question on the structure of polymers is studied. Author

N68-24069# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTION ABOUT PHASE TRANSITIONS IN SOLID BODIES [K VOPROSU O FAZOVYKH PEREKHODAKH V TVERDYKH TELAKH]
R. B. Dobrotin, A. V. Suvorov, and Yu. V. Kondrat'yev *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 115–120 refs (See N68-24058 13-06)

The heat absorption in the temperature region of phase transformation of WCl_6 and $TaCl_5$ has been measured. Some considerations concerning the influence of the character of heat transfer in the calorimetric cell on the temperature interval of specific heat anomaly have been expressed. Author

N68-24070# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROKINETIC PROPERTIES OF DEPOSITS OF COPPER FERROCYANIDE OBTAINED IN DIFFERENT CONDITIONS [ELEKTROKINETICHESKIYE SVOYSTVA OSADKOV FERROTSIANIDA MEDI, POLUCHENNYKH V RAZLICHNYKH USLOVIYAKH]
I. F. Karpova, V. N. Smirnova, and D. A. Fridrikhsberg *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 121–127 refs (See N68-24058 13-06)

The charge of precipitates measured in KCl and HCl solutions depends on the anionic nature of copper salt employed for precipitation. The precipitates formed under the conditions of the excess of copper ions are positively charged in the cases of copper sulfate and copper chloride. In other investigated cases the charge is negative. In $CuCl_2$ solutions all precipitates acquire positive charge. Surface conductance has a minimum and in some cases reaches zero at the isoelectric point. Author

N68-24071# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEPARATING AND IDENTIFYING REACTION PRODUCTS OF DEEP SPLITTING OF GERMANIUM BY FAST PROTONS [RAZDELENIYE I IDENTIFIKATSIYA PRODUKTOV REAKTSII GLUBOKOGO RASSHCHEPLENIYA GERMANIYA BYSTRYMI PROTONAMI]

A. N. Murin, S. B. Tomilov, and I. A. Yutlandov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 129–135 refs (See N68-24058 13-06)

A germanium target was irradiated with 660 Mev protons. The spallation products were separated by ion-exchange chromatographic methods. Identification of isotopes and check of radiochemical purity of separated fractions were carried out by means of a gamma spectrometer. A 145 keV γ-line found in the zinc fraction was ascribed to Zn^{72}. Author

N68-24072# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMODYNAMIC INVESTIGATION OF SOLID SOLUTIONS IN A SODIUM CHLORIDE–POTASSIUM CHLORIDE–CADMIUM CHLORIDE SYSTEM AT TEMPERATURES OF 540, 580, 623°C [TERMODINAMICHESKOYE ISSLEDOVANIYE TVERDYKH RASTVOROV V SISTEME SODIUM CHLORIDE–POTASSIUM CHLORIDE–CADMIUM CHLORIDE PRI TEMPERATURAKH 540, 580, 623°C]

M. M. Shul'ts and I. M. Bushueva *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 137–148 refs (See N68-24058 13-06)

The activities of the components of the solid solutions NaCl–KCl–CdCl at 540°, 580°, 623°C have been determined by the method of the third component. The $\Delta\phi$, ΔH, ΔS of the formation of these solid solutions were calculated. Author

N68-24073# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AMPEROMETRIC TITRATING CERTAIN CATIONS BY TRILON B WITH REVOLVING MICROPLATINUM ELECTRODES [AMPEROMETRICHESKOYE TITROVANIYE TRILONOM B NEKOTORYKH KATIONOV S VRASHCHAYUSHCHIMSYA MIKROPLATINOVYM ELEKTRODOM]

L. S. Reyshakhrit, M. P. Pustoshkina, and Z. I. Tikhonova *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 149–153 refs (See N68-24058 13-06)

An investigation of the oxidation process of trilon B has been carried out on rotating platinum anodes in solutions of 0.1 n NH_4NO_3 + NH_4OH (PH = 8.2–10.0) and 1 n KNO_3 (PH = 5.7) at 20°C. The oxidation rate is determined by diffusion at potentials more positive, than +0.7 v and +0.85 v respectively. Demonstrated is the possibility of amperometric titration with a microplatinum rotating electrode of $Sr(NO_3)_2$ solutions against 0.1 n NH_4NO_3 + NH_4OH and those of $CuSO_4$, $NiSO_4$, H_7 [$P(Mo_2O_7)_6$]—against 0.2 n KNO_3 with the contents of Sr, Cu, Ni and Mo from 0.25 to 70 mg using trilon B. Author

N68-24074# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OXIDATION RATE OF COPPER DURING BRIEF HEATING TO HIGH TEMPERATURES [SKOROST' OKISLENIYA MEDI PRI KRATKOVREMENNYKH NAGREVAKH DO VYSOKOY TEMPERATURY]

V. I. Tikhomirov and E. I. Korytkova *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 155–162 refs (See N68-24058 13-06)

The methods of investigation of the oxidation rate of metals and alloys during heatings of short duration (about some seconds) up to high temperatures have been developed. It has been shown that copper oxidation during heatings of short duration (10–20 seconds) up to 1020°–1070°C follows the parabolic law. When the temperature decreases as low as 900°–1000°C, the linear law beings to predominate. Author

N68-24075# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPECTROPHOTOMETRIC INVESTIGATION OF ASCORBINATE COMPLEXES [SPEKTROFOTOMETRICHESKOYE ISSLEDOVANIYE ASKORBINATNYKH KOMPLEKSOV]

K. P. Stolyarov and I. A. Amantova *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 163–173 refs (See N68-24058 13-06)

The formation of ascorbic complexes of the elements of the second and third groups of the periodic system (excluding strontium and mercury) causes variations in the absorption spectra of simple salt solutions. The maxima of light absorption increase and sometimes shift into long wave region (Pr, Nd, Ho, Er). There is increased absorption in the 320–340 mμk region associated with the displacement of the absorption band of ascorbic acid into long wave region (Zn, Cd and elements of the third group, including B). Obtained for some elements are negative values of optical density in the λ=320–370 mμk region, i.e. light absorption decreases (Be, Zn, Cd, B, Al, Sc, Y, La, Tb, Dy, Ho, Er, Ln). There appear new maxima (Mg 320–340 mμk; Ca and Ba 345 mμk; Zn and Cd 390 mμk). Author

N68-24076# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REDUCING PROPERTIES OF IONITES [VOSSTANOVITEL'NYYE SVOYSTVA IONITOV]

N. A. Nechay, M. N. Zvereva, and T. M. Grekovich *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 175–180 refs (See N68-24058 13-06)

The reducing abilities of certain ionites of Soviet brands were examined in relation to different oxidizers. Static experiments were conducted by means of agitating a suspension of resin (0.5 g) with 50 ml of a solution having a definite concentration of oxidizer and hydrogen ions. Time of agitation (2 to 10 hours) necessary to establish equilibrium between the resin and the solution was determined. Author

N68-24077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFRARED ABSORPTION SPECTRA OF ANHYDROUS SULFURIC AND ORTHOPHOSPHORIC ACIDS [INFRAKRASNYYE SPEKTRY POGLOSHCHENIYA BEZVODNYKH SERNOY I ORTOFOSFORNOY KISLOT]

S. A. Shchukarev, T. G. Balicheva, K. Ya. Borcha, and M. A. Kukhareva *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 181–186 refs (See N68-24058 13-06)

The infrared absorption spectra from 3700 to 2350 cm^{-1} of concentrated anhydrous sulfuric and orthophosphoric acids at 20°C and in the region of valent O–H vibrations at −40°C have been studied. The roughly estimated values of the force constant and those of the interatomic O–H bond length in these acids point to the considerable increase of the strength of hydrogen bonds among molecules in the series $HClO_4$ < H_2SO_4 as the length of the O–H bond increases. Molar absorption coefficients of sulfuric and orthosphoric acids have been determined. Author

N68-24078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEPENDENCE OF ORIENTATION ANGLE OF DOUBLE REFRACTION IN FLOW ON CONCENTRATION OF SOLUTION [ZAVISIMOST' UGLA ORIYENTATSII DVOYNOGO LUCHEPRELOMLENIYA V POTOKE OT KONTSENTRATSII RASTVORA]

V. P. Budtov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 189–193 refs (See N68-24058 13-06)

An analytic study has been made of concentration dependence of the extinction angle in polymer solutions for 6 fractions of PMMA in solvents of high ($3 \leq \eta_o \leq 15.6$ sp, tetrabromoethane) and low ($\eta_o < 1$ sp, acetone, bytylacetate, ethylacetate, methyl-ethyl ketone) viscosities. Some methods of extrapolation have been offered for polymer concentration in solution (tending towards zero) in the high viscosity solvents. Author

N68-24082# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AVERAGE HEAT CAPACITY OF SOLID Fe_2O_3–Al_2O_3 SOLUTIONS AT HEIGHTENED TEMPERATURES [SREDNYAYA TEPLOYEMKOST' TVERDYKH RASTVOROV Fe_2O_3–Al_2O_3 PRI PROVYSHENNYKH TEMPERATURAKH]

Yu. G. Popov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 207–210 refs (See N68-24058 13-06)

The mean heat capacities of solid solutions of the Fe_2O_3–Al_2O_3 system have been found to be a linear function of the composition. This in good agreement with the assumption of the segregation of aluminium and iron atoms. Author

N68-24083# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON CHLORONIOBATES OF ALKALI METALS WITH COMPOSITION OF Me_2 $NbOCl_5$ [OB OKSILHLORONIOBATAKH SHCHELOCHNYKH METALLOV SOSTAVA Me_2 $NbOCl_5$]

Ye. K. Smirnova and I. V. Vasil'kova *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 211–212 refs (See N68-24058 13-06)

The K_2NbOCl_5, Rb_2NbOCl_5, Cs_2NbOCl_5 have been synthesized, and the reactions of their hydrolysis have been investigated. The examined compounds have been shown to crystallize into the cubic system according to the K_2PtCl_6 type. Author

N68-24084# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF ULTRASONICS TO ACCELERATE QUANTITATIVE DEPOSITION OF CALCIUM, MAGNESIUM AND BARIUM [PRIMENENIYE UL'TRAZVUKA DLYA USKORENIYA KOLICHESTVENNOGO OSAZHDENIYA KAL'TSIYA, MAGNIYA I BARIYA]

V. V. Vasil'yev and I. L. Sit'ko *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 213–217 refs (See N68-24058 13-06)

The data on the application of ultrasonics in analytical chemistry are given. In using ultrasonic quantitative precipitation of barium sulfate, magnesium and ammonium diphosphate and calcium oxalate may be achieved for five minutes instead of lengthy exposure of the precipitate with mother liquor to heating or leaving them overnight before filtering. Author

N68-24120 Brigham Young Univ., Provo, Utah.

HIGH PRESSURE, HIGH TEMPERATURE SYNTHESIS OF BORON MONOSULFIDE

Duane Clifton Carlson (Ph.D. Thesis) 1966 77 p

Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-572

Application of high pressure and high temperature has been used to synthesize a new compound: boron monosulfide. Two polymorphs have been made by varying the temperature. A cubic phase was formed at 60 kilobars pressure and 1500°C, and an orthorhombic phase was formed at 60 kilobars and 1400°C. The synthesis procedure has been optimized and the best results were obtained at these conditions using water as a mineralizer. The cubic material is very stable at atmospheric conditions and does not react with common acids or bases. Its density was measured to be 2.52 gm/cm^3 in the powder form with some of the larger crystals measuring at 2.58 gm/cm^3. It is a light olive color in the powder form and the larger crystals are transparent with a deep yellow color. The orthorhombic material is a light tan color and its density was measured to be 2.53 gm/cm^3. The crystal systems of the two polymorphs were determined by X-ray diffraction. Dissert. Abstr.

N68-24197 Joint Publications Research Service, Washington, D. C.

MULTIPHOTON EXCITATION OF ORGANIC MOLECULES

A. M. Prokhorov, V. D. Shigorin, and G. I. Shipulo 14 May 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 175, no. 4, 1967 p 793–796

(JPRS-45377) CFSTI: $3.00

Multiphoton excitation of complex organic molecules with subsequent luminescence and decay deactivation was studied by UV light at 365 mμ and by irradiation from modulated ruby laser with a peak power at 40 milliwatts. Ruby induced fluorescence maxima in polycrystalline samples of N-ethylacridone were 460 mμ and 420, 435, 485, 500, 525, and 550 mμ in compounds I–VI respectively; phosphorescence absence in benzoquinone, naphthoquinone, anthraquinone and N-ethylacridone was explained by the weak excitation intensity; the corresponding compounds exhibited phosphorescence readily after constant excitation by UV light. This absence of absorption in all investigated compounds at the frequency of the laser's emission and the proportionality of the fluorescent intensity to the square of the intensity of the laser's light indicated a biphoton mechanism of excitation. Ruby and dysprosium laser effects on the photolysis of nitro-derivatives of benzene and naphthalene showed a more intensive breakdown in ruby excitation of the electron states; NO radicals were produced when the compounds were exposed to UV light. It was concluded that excitation can take place both directly as well as through electron excitation of the molecule with subsequent redistribution of the energy. G.G.

N68-24233# Stanford Research Inst., Menlo Park, Calif. Chemical Dynamics Dept.

DIFFUSION AND HETEROGENEOUS REACTION II. THEORETICAL ANALYSIS OF NONSTEADY-STATE KINETICS Technical Report

Y. Rajapakse and H. Wise Nov. 1967 21 p refs Prepared in cooperation with Purdue Univ.

(Contracts N00014-67-A-0226-0005; Nonr-3623(00); Proj. Squid) (SU-SRI-25-P; AD-667611)

The theoretical analysis of a transient method is presented for the quantitative study of heterogeneous reaction rates and gaseous, multi-component diffusion coefficients. From observations of the rate of decay of reactant after its source of supply has been shut off, the kinetics of chemical reaction on the catalytic surface may be obtained. Combined with steady-state measurements, the diffusional transport of reactant to the catalyst may be evaluated. This experimental approach is particularly applicable to systems involving highly reactive species such as free radicals and atoms. Author (TAB)

N68-24253 Pennsylvania Univ., Philadelphia.

THE EFFECT OF INTRAPARTICLE DIFFUSION ON SINGLE STEP DEUTERIUM-HYDRIDE EXCHANGE REACTIONS

Francis Gerard Dwyer (Ph.D. Thesis)

Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-3064

This research is aimed at experimentally demonstrating the effect of intraparticle diffusion on a complex chemical reaction effect and extracting effective diffusion parameters from the

experimental results. The deuterium exchange of neopentane was selected as the complex chemical reaction to be studied. This reaction, when catalyzed by palladium, was reported to be a single step exchange mechanism. The amount of deviation was consistent with the amount of diffusional resistance present. Since product distributions that deviate from that of a single step exchange mechanism are indicative of multiple step exchange, the experimental results substantiate the predicted mechanistic distortion.
Dissert. Abstr.

N68-24254 Louisiana State Univ., Baton Rouge.
THE EFFECT OF A SECOND ORDER CHEMICAL REACTION ON THE ABSORPTION OF METHYL MERCAPTAN IN A LAMINAR LIQUID JET
Joseph Earl Landry (Ph.D. Thesis) 1966 188 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-1170

The laminar liquid jet was chosen to obtain the basic absorption data on the methyl mercaptan-sodium hydroxide system, because its unique fluid dynamic and operating characteristics allow the use of the penetration theory for the description of the process. The absorption of methyl mercaptan in aqueous solutions of sodium hydroxide, as measured in the laminar liquid jet apparatus, were correlated by the penetration theory solutions for an infinitely fast irreversible reaction. The reaction of the dissolved methyl mercaptan with the hydroxyl ions was very fast second order irreversible reaction with a forward rate constant in the order of 10^5 liters/gram-moles-second. The absorption of dilute gas solutions of methyl mercaptan in aqueous sodium hydroxide contacted in a packed absorber was predicted by a method of calculation based on the penetration theory. It was further found that the height of chemical absorbers can be calculated once reaction kinetics and the physical constants are known. Dissert. Abstr.

N68-24266 Pennsylvania State Univ., University Park.
TRANSIENT PHENOMENA IN THE GASIFICATION OF GRAPHITE BY CARBON DIOXIDE
Mordecai Shelef (Ph.D. Thesis) 1966 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-1952

In mixtures of non-purified Co and CO_2, the steady-state rates were reproduced within 20 percent, which is considered satisfactory in the case of carbon reactions. The steady-state rates attained in purified mixtures were of a similar magnitude. On the other hand, when the gasification was started in purified CO_2, a transient rate was observed which attained values exceeding the steady-state rates by a factor up to 50. This transient, fast-rate gasification was studied in depth. It was established that the transient rate can be induced in the 940–1070°C temperature range and cannot be observed if hydrogen-containing impurities or large amonts of CO are initially present in the system. When undisturbed, the transient rate decays spontaneously to values usually observed during steady-state gasification. Addition of hydrogen sharply quenches these transients while the effect of CO addition is slight, once the transient has already developed. The gasification at fast rates is associated with a rapid increase of the total surface area of the graphite. Dissert. Abstr.

N68-24271 Arizona Univ., Tucson.
HIGH TEMPERATURE X-RAY DIFFRACTION STUDIES IN SELECTED RARE EARTH OXIDE-OXYGEN SYSTEMS
Daniel Arthur Burnham (Ph.D. Thesis) 1967 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-3195

High-temperature X-ray diffraction was used to study the stability regions of the intermediate phases in the systems, praseodymium oxide-oxygen, terbium oxide-oxygen, and cerium-terbium oxide-oxygen. Lattice parameters were determined by a least-squares analytical treatment with the aid of a CDC 3400 Computer. The isobaric studies of the praseodymia and terbia systems, in which the the reaction path was traced in reduction on heating, then in oxidation on cooling, showed that single phases existed in single phase regions indicated by previous tensimetric studies, and that two phases existed in diphasic regions. The presence of hysteresis was confirmed. In all hysteresis loops examined, two phases were present. A disymmetry in the hysteresis loops between reduction and oxidation paths was manifested; if a disorder → order transformation was involved, the diphasic temperature range was extended. Dissert. Abstr.

N68-24277 Maryland Univ., College Park.
THE SYNTHESIS OF SPIRO AND RELATED POLYMERS
Angelo Anthony Volpe (Ph.D. Thesis) 1966 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-2351

The hypotheses were tested that double-chain spiro or ladder polymers should be more stable toward chemical or thermal degradation than single chain polymers and that double-chain polymers which contain large rings should be more flexible and, consequently, more soluble than ones with rigidly fused small rings. Two approaches were employed: (1) the synthesis of spiro polymers by the condensation of pentaerythritol with large and small ring diketones and (2) the attempted synthesis of large ring bifunctional dienophiles which would be capable of reacting with bifunctional dienes in a Diels–Alder reaction to give ladder polymers containing large, flexible rings in their structure. The synthesis of the first completely organic spiro polymers was accomplished by the acid-catalyzed condensation of pentaerythritol with a six-membered ring diketone and an eighteen-membered ring diketone. It was found that the small ring polymer exhibited greater thermal stability than the large ring one but was not as flexible or as soluble.
Dissert. Abstr.

N68-24279 Maryland Univ., College Park.
FILM DIFFUSION CONTROLLED ION EXCHANGE INVOLVING A SELECTIVE RESIN
Joseph P. Copeland (Ph.D. Thesis) 1966 177 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-2380

The forward and reverse exchanges of sodium for hydrogen and silver for potassium on DOWEX 50 W–X8 were studied. Thin bed experiments were conducted under such conditions that film diffusion controlled the exchanges. Effluent concentration histories were obtained by means of a flow conductivity cell. Flow rate, solution counter-ion concentration, co-ion, bed thickness, resin selectivity for the ion paris, bed porosities, and resin water content were studied. A material balance for the thin bed was combined with the experimental breakthrough data to obtain average surface fluxes and resin loadings as functions of time. A flux relationship derived from the Nernst–Planck equation was fitted to these parameters to calculate an hypothetical film thickness. A new dimensionless equation was derived which correlated all of the film thicknesses for both pairs of ions studied. Nernst–Planck equations were derived for selective resin, and the unit-selectivity solution of Schlögl and Helfferich is included. Dissert. Abstr.

N68-24280 Maryland Univ., College Park.
DETERMINATION OF ALUMINUM AND CADMIUM BY NEUTRON ACTIVATION OF THEIR CHELATES
Gareth La Verne Reed (Ph.D. Thesis) 1966 92 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-2394

Neutron activation analysis of aluminum and cadmium by using an activatable-isotope labeling technique was investigated. The elements were labeled with stable bromine by forming a metal

chelate using 5, 7-dibromo-8 quinolinol reagent. Preirradiation separation was affected by using solvent extraction and paper chromatography techniques to isolate the pure chelate compound. Chromatograms containing isolated aluminum and cadmium dibromoxine was irradiated with a flux of 10^{11}n/cm^2/sec. The induced Br^{82} activity was counted with a well type NaI crystal and a single channel spectrometer. This method has resulted in the quantitative determination of aluminum and cadmium at concentration levels of 0.01 and 1.2 μg, respectively, with a total integrated activation flux of 3×10^{15}nvt. The measured sensitivity of this method is three and ten times better for aluminum and cadmium, respectively, than the sensitivities for direct activation of these metals based on obtaining 1000 dpm after irradiation for eight hours at a thermal neutron flux of 10^{11}n/cm^2/sec.
Dissert. Abstr.

N68-24281 Iowa State Univ. of Science and Technology, Ames.
NUCLEATION AND GROWTH KINETICS IN A COOLING CRYSTALLIZER
Carroll Wilson Chambliss Ph.D. Thesis) 1966 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-2065

A laboratory continuous, mixed suspension, mixed product removal, cooling crystallizer was designed and operated to obtain crystal growth and nucleation rates. An analysis proposed by previous investigators based on a crystal population balance for both steady state and transient crystallizer conditions was used to determine the kinetic rates from product size distribution for ammonium alum and ammonium sulfate. While the classic theories express nucleation rate as a complex function of supersaturation, a simple power model appears to be sufficient to correlate nucleation and growth rates in such a way as to make possible the prediction of size distribution. Nucleation rate varied linearly with suspension density suggesting that crystals already in suspension were a heterogeneous source of nuclei and that for the systems studied this mode of nucleation was predominant. As a result of this linear dependence, increasing the amount of solids in suspension did not change the size distribution. If there had been no dependence on the solids in suspension, the size distribution would have been enhanced. Enhancement of the size distribution was achieved, however, by increasing the residence time. Dissert. Abstr.

N68-24288# Kernforschungsanlage, Juelich (West Germany).
FORMATION OF SULPHUR 35 IN NEUTRON IRRADIATED REACTOR GRAPHITE [BILDUNG VON SCHWEFEL-35 IN NEUTRONEN-BESTRAHLTEM REAKTOR-GRAPHIT]
M. Laser, E. Merz, and H. J. Riedel Brussels EURATOM Mar. 1968 10 p ref In GERMAN; ENGLISH summary
(Contract EURATOM-003-63-1 RGAD)
(THTR-51; EUR-3894.D) CFSTI: HC $3.00/MF $0.65

In the neutron activation of different reactor-grade graphites, the formation of relative strong ^{35}S-radioactivities were observed. As the present investigation shows, their formation results from the nuclear reaction ^{35}Cl(n,p)^{35}S of the chlorine impurities present in most reactor graphites from the chemical high temperature purification process using halogene containing compounds. An activation analysis technique was used to determine the chlorine content of different graphite specimens and also to estimate their sulphur impurities. The observations in connection with the volatilization of the formed sulphur-35 are presented. Author

N68-24294 Joint Publications Research Service, Washington, D. C.
RESEARCH ON THE NATURE OF THE CHEMICAL BOND IN ALUMINIDES OF CERTAIN TRANSITION METALS
G. V. Samsonov and V. S. Sinel'nikova 15 May 1968 15 p refs Transl. into ENGLISH from Neorganichesk. Mater. (USSR), v. 1, no. 7, 1965 p 1071–1078
(JPRS-45385) CFSTI: $3.00

On the basis of X-ray diffraction studies of the aluminides of iron, nickel, manganese, and chromium, it is concluded that there exists a strong overlapping of the 3d and 4s wave functions of the atoms of the transition element with the 3p wave functions of the aluminum atoms. The formation of spd hybrid bonds produces the characteristic features and properties of the aluminides. By studying the electron density in crystals of nickel, aluminum, and the nickel aluminide NiAl, the conclusion was reached that in the typical electron compound NiAl covalent bonds are formed between atoms of nickel and aluminum, as well as between nickel atoms. We studied some galvanomagnetic and electrical properties of the aluminides of titanium, zirconium and vanadium, and niobium and tantalum, and measured the temperature dependences of the electrical resistance and absolute differential thermoelectromotive force of the aluminides of certain transition metals. The specific electrical resistance of the aluminides as a function of the temperature shows the dependence on the relative content of aluminum, from which it follows that the higher aluminides have the minimal specific electrical resistance. Author

N68-24295 Pennsylvania State Univ., University Park.
CHEMICAL REACTION IN AN ELECTRICALLY HEATED POROUS MEDIUM
Jerome Farber (Ph.D. Thesis) 1966 202 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-1921

The main objective was to develop a heat generating porous tube reactor for the study of fast reactions at high temperatures. The high rate of heat transfer, due to the high surface to volume ratio of the porous tube, was expected to result in an essentially constant fluid temperature, which is ideal for kinetic studies. A second objective was to study the kinetics and product distribution for the industrially important thermal decomposition of ethane to ethylene and acetylene. The product distribution was studied as a function of temperature, residence time, and ethane partial pressure, to determine the effects of time-temperature patterns on the product selectivity. Dissert. Abstr.

N68-24308 Iowa State Univ. of Science and Technology, Ames.
GEOMETRIC CONSTRAINTS IN ELECTRON DIFFRACTION ANALYSIS: STRUCTURE OF HYDROCARBON MOLECULES
Thomas Leslie Boates (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-2063

Two least squares programs for analyzing electron diffraction data were developed which imposed geometrical constraints on the internuclear distances. One of the programs was used in the analysis of intensity data, and the other in the analysis of radial distribution data. Both programs incorporated more accurate corrections for anharmonicity of vibration and failure of Born approximation than had been used previously. The programs were designed to analyze data directly in terms of a set of geometrically independent internal coordinates. The programs were written to take full advantage of any molecular symmetry properties. A comparison of the two analyzing techniques was made in the determination of several molecular structures. Dissert. Abstr.

N68-24321 Maryland Univ., College Park.
THE GLOW DISCHARGE DECOMPOSITION OF AMMONIA
Donovan Charles Carbaugh (Ph.D. Thesis) 1966 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-2365

The decomposition of ammonia in an alternating current glow discharge was studied over a range of flow rates at several levels of pressure and discharge current. Discharge emission spectra from 3000 Å to 7000 Å were measured for hydrogen, nitrogen, and decomposing ammonia. In the ammonia spectrum the intensities of emission lines from atomic hydrogen and from NH_2 radicals were

followed over a range of ammonia flow rates to get information on radical concentration and excitation levels. In addition to nitrogen and hydrogen, hydrazine was obtained as a product in yields up to 3.1% based on ammonia reacted. Decomposition data at 1.7 mm Hg pressure and at three discharge currents fell on a single curve when percentage decomposition was plotted as a function of residence time multiplied by current. This method was also found to correlate hydrazine yields. The conclusions reached concerning the mechanism of the reactions were consistent with the steps that have been proposed for the photochemical decomposition of ammonia. Dissert. Abstr.

N68-24334# Japan Atomic Energy Research Inst., Tokyo.
A TRIAL METHOD OF DETERMINING URANIUM AND THORIUM CONTENT IN ROCKS BY THE RADIOACTIVE MEASUREMENTS
Susumu Nishimura, Zin'ichiro Hatuda, and Tetsuji Asayama Feb. 1968 17 p refs Transl. into ENGLISH from Radioisotopes (Tokyo), v. 15, no. 6, Nov. 1966 p 289–294
(NSJ-TR-103) CFSTI: HC $3.00/MF $0.65

Some radioactive rocks or minerals show radioactive disequilibrium, because of the various geochemical processes to which they have been subjected. If any gain or loss of radioactive isotopes has occurred within the last period of about 10^6 years, the rock will be in a state of radioactive disequilibrium. In this case, the method described in the first report will be inadequate. For the purpose of finding a proper method for studying radioactive disequilibrium of samples, the methods using a radioscope, alpha-scintillation counter and gamma-ray spectrometer were re-examined. As the result, combination of gamma-ray spectrometry with alpha-ray counting by a scintillation counter was found to be appropriate for the purpose. Author

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-23126 Stanford Univ., Calif.
SIGNAL OPTIMIZATION FOR CHANNELS WITH FEEDBACK
Jimmy Kazuhiro Omura (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-4416

In this work, a communication receiver is regarded as a dynamical system described by a linear difference equation where the last state is the test statistic upon which a decision is based. When noiseless feedback to the transmitter is allowed, the signal selection problem becomes essentially a stochastic control problem. By choosing a minimum mean square error criterion, signals are found that exploit the feedback to achieve considerable reduction in coding and decoding complexity over what would be needed for comparable performance with the best signals for the one-way channel. The schemes developed exhibit error probabilities that decrease in a double exponential manner with increasing signal duration for both additive and multiplicative noise channels. This control theory approach depends only on the first- and second-order statistics of the noise, handles multiplicative noise in addition to additive noise in the forward channel, and extends naturally to consideration of noise in the feedback link. Dissert. Abstr.

N68-23137# Air Force Missile Development Center, Holloman AFB, N. Mex.
FOUR METHODS OF SOLVING FOR THE SPHERICAL ERROR PROBABLE ASSOCIATED WITH A THREE-DIMENSIONAL NORMAL DISTRIBUTION
Richard J. Schulte and Donald W. Dickinson Jan. 1968 58 p refs
(MDC-TR-68-12; AD-666646)

When the predicted position of a satellite contains normally distributed errors, the position uncertainty can be described by a Spherical Error Probable or SEP. The SEP is calculated by integrating the three-dimensional normal probability density function over a spherical volume. The SEP is set equal to the radius of that volume which contains the satellite with 50% probability. In this report the authors present four methods for integrating the density function and finding the SEP. The three normal variates in the density function are assumed to be independent and unbiased with known variances. Author (TAB)

N68-23143# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
MATCHED-FILTER RESPONSES OF THE LINEAR FM WAVEFORM Research Report, Sep. 1966–Jun. 1967
R. L. Mitchell and A. W. Rihaczek 7 Feb. 1968 49 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-46)-6; SAMSO-TR-68-104; AD-666661)

Although the properties of the linear FM signal have been studied previously in considerable detail, such studies have involved rather narrow aspects of the theory. This paper extends the work in several respects. By presenting three-dimensional plots of the conventional ambiguity function of the linear FM signal in more detail than available before, we can study the sidelobe behavior off as well as on the axes, without weighting, with unilateral weighting in the receiver, and with bilateral weighting. These plots reveal interesting properties related to the signal symmetry in time and frequency. The matched-filter response then is extended to include Doppler distortions of the modulation function. Plots of the response are presented for various degrees of distortion, for signals with and without weighting. Lastly, we consider the effects of a mismatch in range acceleration, again for the various cases of interest. The results convey a thorough insight into the properties of Chirp radar under a broad range of operational conditions. Author (TAB)

N68-23195# Houston Univ., Tex.
REAL TIME DEEP SPACE TELEVISION
Edward L. Michaels [1967] 21 p refs

The present status of real time deep space television is described for transmitting line images from manned or unmanned spacecraft in deep space to Earth. The initial phase of study is to analyze the problem of efficient transmission of television picture information from deep space, and to recommend an optimum system that is capable of transmitting either still or moving pictures. The picture transmission system is to supply video information that can be processed directly by computers and be handled by electronic data processing equipment designed for other uses. The analog and digital television transmission systems are compared with respect to advantages and disadvantages. Bandwidth compression techniques are examined, and an assessment is made of two picture coding techniques, (1) statistical, and (2) psychovisual. B.S.D.

N68-23245# Aerospace Corp., El Segundo, Calif. Lab. Operations.
DYNAMIC BANDWIDTH OF PHASE-MODULATED SIGNALS, AUGUST–OCTOBER 1967
August W. Rihaczek Feb. 1968 30 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-46)-4; SAMSO-TR-68-102; AD-666915)

A method of signal representation is introduced which simplifies the analysis and provides a better understanding of systems using phase-modulated signals. To replace time function and spectrum, the concept of instantaneous frequency is supplemented by that of dynamic bandwidth. Instantaneous frequency indicates in which part of the spectrum the signal energy is concentrated at a particular time, whereas dynamic bandwidth measures the degree of concentration. The combination of both concepts reveals the nature of a phase-modulated signal in a manner in better agreement with physical intuition than time function and frequency spectrum. A signal with arbitrary phase modulation can be thought of as a succession of elementary constant-carrier pulses of varying duration; or, in the frequency domain, as a succession of spectral bands with linear phase and varying widths. It is shown that this approach permits one to write down results that would take a complicated analysis if conventional methods were used. Author (TAB)

N68-23293# Stanford Research Inst., Menlo Park, Calif.
A SURVEY OF PROGRESS IN CODING THEORY IN THE SOVIET UNION Final Report
William H. Kautz and Karl N. Levitt Dec. 1967 158 p refs
(Contract F44620-67-C-0026; SRI Proj. 6313)
(AFOSR-68-0590; AD-666917)

Described in this report are the results of a comprehensive technical survey of all published Soviet literature in coding theory and its applications--over 400 papers and books appearing before March 1967. The purpose of this report is to draw attention to this important collection of technical results, which are not well known in the West, and to summarize the significant contributions. Particular emphasis is placed upon those results that fill gaps in the body of knowledge about coding theory and practice as familiar to non-Soviet specialists. Author (TAB)

N68-23319# Reza (F. M.), Syracuse, N. Y.
ELEMENTS OF APPROXIMATION THEORY FOR SIGNALS AND SYSTEMS
F. M. Reza Griffiss AFB, N. Y. RADC Feb. 1968 56 p refs
(Contract F30602-68-C-0062)
(RADC-TR-67-648; AD-666938)

The report contains an exposition of the essentials of the theory of linear least square approximation for scientists. Its format is based on the modern methods of functional analysis, namely the projection theory of Hilbert space. The content of the report is best appreciated by the reader who has some knowledge of Hilbert space theory. The unifying concept which prevails throughout the report allows the treatment of the problems of least square approximation in a variety of fields. Applications to problems of linear systems, networks, and communication theory are included. Author (TAB)

N68-23350# Airborne Instruments Lab., Deer Park, N. Y.
SINGLE FREQUENCY F_1, F_1 REPEATER Final Report, 1 Jul.–30 Nov. 1967
G. Johnston, K. Redmond, and G. Thomson Mar. 1968 60 p refs
(Contract DAAB07-67-C-0630; ARPA Order 694)
(AIL-2282-1; ECOM-0630-F; AD-666781)

The objective of the study was to determine the feasibility of new technical concepts inherent in the design of F sub 1, F sub 1 repeaters. This technical report covers two novel versions of small F sub 1, F sub 1 radio repeaters designed for use with FM tactical transceivers. Both developmental models are linear, single frequency repeaters (F sub 1, F sub 1), one is high gain (50 db); the other wide-band (500 kHz). The design of these repeaters utilizes the concepts of hybrid isolation and precise antenna matching. The results indicate that true F sub 1, F sub 1 radio repeaters are feasible. Included are detailed discussions of: F sub 1, F sub 1 repeater concept; antenna matching and broadbanding techniques; hybrid isolation; amplifier and filter development; tests and evaluation; miniaturization; future trends and goals. Author (TAB)

N68-23390 Mississippi State Univ., State College.
ANALYSIS AND DESIGN OF INFINITE MEMORY DIGITAL FILTERS
Cecil Orie Alford (Ph.D. Thesis) 1966 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-3984

The first part is an introduction to the Wiener filter problem and its extension to digital filters. The problem to be solved is as follows: Given a signal which can be described as the sum of a polynomial and uncorrelated white or "almost white" noise, find the infinite memory digital filter which minimizes the output mean-squared error under the constraint that the output in the absence of noise has zero output error. The second part consists of an analysis of the general problem when restricted to the first order infinite memory filter. This filter is distinguished by having a denominator of the first order. The third part is an extension of the second part to the second order infinite memory filter. This filter is distinguished by having a denominator of the second order. The fourth part is a presentation of the characteristics of the digital filters of the second part. Dissert Abstr.

N68-23431# Michigan Univ., Ann Arbor. Willow Run Labs.
PARAMETER ESTIMATION FOR STOCHASTIC SIGNALS WHICH ARE COHERENT IN PAIRS
Ferrell G. Stremler Feb. 1968 21 p refs
(Contract DA-28-043-AMC-00013(E); Proj. Michigan)
(Rept.-6400-150-T; ECOM-00013-150; AD-666777)

A general expression for the likelihood functional for the coherent multiple-sensor problem is developed using Gaussian statistics on both signal and noise. With strongly correlated stochastic signals, a singularity problem arises; to avoid this difficulty, a complex representation for the signal is used, and the likelihood functional is averaged over the real and imaginary parts of the signal. A solution to the likelihood equation for an estimate of the parameter change between signals and a bound on the variance are found. An example of a two-sensor problem in phase-difference estimation is also given. Author (TAB)

N68-23434# Naval Research Lab., Washington, D. C.
FREQUENCY-ERROR INDICATOR FOR MULTIPLEX TELETYPE SIGNALS Interim Report
D. A. Venn, L. M. Leibowitz, and B. A. Tretick 5 Dec. 1967 12 p ref
(NRL-MR-1840; AD-664654)

The need for highly accurate, precise, and rapid frequency monitoring of Naval communications circuits and systems has led to the development of a new technique for on-line determination of the frequency of each tone of a 16-channel frequency-shift keyed (FSK) multiplex (MUX) teletype signal to within 1 hertz (Hz). Frequency mixing and filtering, in combination with precise digital timing and counting circuitry, is used to generate a start-stop pulse for time interval measurement. A counter utilizing the output of the monitor and high-frequency input from a precise frequency standard for reference provides instant display of MUX tone frequency for determination of frequency error and other supervisory purposes. Author (TAB)

N68-23472 Mississippi Univ., University.
DETECTION OF A NARROW BAND NOISE SIGNAL AS A FUNCTION OF THE CORRELATION OF THE SIGNAL AND A MASKER

Charles Tillman Dunn (Ph.D. Thesis) 1968 45 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6442

Two experiments are reported which involve the detection of a narrow band noise signal (centered at 250 Hz) in a wide band noise masker as a function of the correlation of the signal and the masker. The phase relations were random at either ear due to the fact that the signal and the masker were obtained from independent noise generators. The first experiment employed a rating method, and the second experiment employed a two interval forced-choice procedure. Detection was much better with a correlated masker than with an uncorrelated masker. With a correlated masker, decreasing the signal correlation resulted in improved detection; with an uncorrelated masker, decreasing the signal correlation had a negligible effect on detection. These results were discussed in terms of the detection of a reduction in the interaural correlation of the masker which occurs when the signal is added. Dissert. Abstr.

N68-23478*# Ohio State Univ., Columbus. ElectroScience Lab.
THE INFLUENCE OF CONDUCTING FLAPS ON THE REFLECTION COEFFICIENT OF A PARALLEL-PLATE WAVEGUIDE ILLUMINATING A CONDUCTING SHEET
L. L. Tsai and R. C. Rudduck 9 Apr. 1968 58 p refs
(Grant NGR-36-008-048)
(NASA-CR-66621; TR-2143-5) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The influence of conducting flaps on the reflection coefficient of a ground-plane-mounted TE_{01} mode parallel-plate waveguide illuminating a reflecting sheet is analyzed. The backscatter from the guide is determined by use of wedge diffraction and surface integration techniques. The reflection coefficient of the guide is then obtained through an iterative procedure that describes the multiple interactions between the guide and reflector as bouncing cylindrical waves. The optimum flap length produces a significant reduction in the backscatter from the guide and consequently a significant reduction in the oscillations of the reflection coefficient. Author

N68-23479*# Ohio State Univ., Columbus. ElectroScience Lab.
THEORETICAL AND EXPERIMENTAL STUDIES OF ANTENNAS FOR REFLECTOMETER APPLICATION Final Engineering Report, 1 Dec. 1965–29 Feb. 1968
10 Apr. 1968 10 p refs
(Grant NGR-36-008-048)
(NASA-CR-66620; Rept.-2143-6) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The accomplishments of a research program on theoretical and experimental studies of antennas for reflectometer application are summarized. Three basic areas were investigated toward achieving improved reflectometer design. The reflection coefficient of a parallel-plate waveguide illuminating a conducting sheet was analyzed as a function of the distance to the reflecting sheet. The influence of conduction flaps attached at antenna apertures was investigated both theoretically and experimentally and has been shown to yield considerable reduction in backscatter and hence less oscillatory response in the reflectometer. The effect of dielectric media on the aperture admittance of circular waveguides was also analyzed. Author

N68-23523*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INTERCOMPARISON OF SOME RESULTS FROM GEOS-1 DATA BASED UPON SECOR SHORT ARC VS. OPTICAL LONG ARC REFERENCE ORBITS
Francis J. Lerch, James G. Marsh, Samuel J. Moss (Wolf Res. and Develop. Corp.), and Brian O'Neill (Wolf Res. and Develop. Corp.) Mar. 1968 69 p refs
(NASA-TM-X-63199; X-552-68-101) CFSTI: HC $3.00/MF $0.65 CSCL 17I

Optical reference orbits were taken as a standard for this evaluation and compared with results obtained using U.S. Army Sequential Collation Range (SECOR) short arcs as a reference. The optical reference orbits utilized GEOS-I flash sequence data and some passive observations from five major geodetic optical tracking networks. The networks and camera types consisted of the Smithsonian Astrophysical Observatory Baker–Nunn, the Goddard Space Flight Center STADAN and Special Optical Tracking System Minitrack Optical Tracking System 40" and 24", United States Air Force PC-1000, and the United States Coast and Geodetic Survey BC-4. The SECOR data consisted of fourteen station passes during four quad passes over the United States. Simultaneous data from the Goddard Range and Range Rate System were also available during these four passes affording the opportunity to intercompare the evaluation of this instrument based on an optical reference orbit with earlier results obtained using the SECOR data as a standard. Author

N68-23610*# RAND Corp., Santa Monica, Calif.
TRANSIONOSPHERIC PROPAGATION OF PULSED SIGNALS
W. Sollfrey May 1968 49 p refs
(Contract NASr-21)
(NASA-CR-94602; NASr-21(02); RM-5558-NASA) CFSTI: HC $3.00/MF $0.65 CSCL 17B

This study considers the distortion of a pulsed signal as it is transmitted through the earth's ionosphere. The efficient use of the power available from satellites requires the use of wide-band transmission, corresponding to short pulses. These pulses may be distorted by the dispersive effects of the ionosphere, with the effects greater at the lower carrier frequencies and during periods of solar activity. This memorandum studies the phenomena and provides a means for computing the resulting distortion. The results can be used as an aid for designing satellite systems which employ time-division multiplexing or other types of pulse transmission systems. Author

N68-23615# Harry Diamond Labs., Washington, D. C.
ACTIVE AND ACOUSTIC LOW-PASS FILTERS FOR SUBCARRIER OSCILLATORS IN HIGH-G TELEMETRY
Robert E. Elmore Dec. 1967 26 p refs
(HDL-TM-67-24; AD-666754)

As part of telemetry research, a low-cost, low-distortion, active, low-pass filter was designed, built, and tested to replace the LC low-pass filter in IRIG subcarrier oscillators. An acoustic filter, which could be used instead of the electrical filter, was also designed, but it has not been built. Author (TAB)

N68-23628 Missouri Univ., Rolla.
NONPARAMETRIC DETECTION OF SIGNALS CAUSING ARBITRARY CHANGES IN THE ACCOMPANYING NOISE BACKGROUNDS
John Joseph Komo (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-55

This paper treats the problem of detecting signals that when added to noise can change the noise distribution in any respect whatsoever. The detectors considered are nonparametric in nature in that there is less than a complete statistical description of the signal and the noise available. These nonparametric detectors are advantageous in that they are not limited to one specific class of signals, but are appropriate for any class of signals. This paper covers both one-input and two-input nonparametric detectors, which are compared with the optimum parametric detectors (optimum only in gaussian noise and for a gaussian signal plus noise) for signals which change the dc level of the noise distribution and signals which change the power of the noise distribution. Finally as an application, a nonparametric detector is used to detect a Frequency Modulated (FM) signal in noise for various signal to noise ratios. Dissert. Abstr.

N68-23721*# Ryan Aeronautical Co., San Diego, Calif.
SCATTEROMETER DATA ANALYSIS PROGRAM Final Report
W. L. Floyd 21 Sep. 1967 347 p refs
(Contract NAS9-6059)
(NASA-CR-62072; Rept.-57667-2) CFSTI: HC $3.00/MF $0.65 CSCL 17I

Scattering data were gathered simultaneously at all angles of incidence for known and identifiable terrain resolution elements by using a 13.3 GHz radar Doppler (REDOP) scatterometer installed aboard a Convair 240 aircraft and flown over various sites in the United States selected to simulate the lunar terrain. To provide measurements of backscattering coefficient per unit surface area for various types of earth terrain, an RF reflectivity program was conducted. Reflectivity was determined for sand, desert, volcanic, and other surface formations; and reflectivity was measured as a function of time for a given surface and of altitude above that surface. Reflectivity signature of various types of terrain discontinuities were studied for possible use in the selection of a lunar landing site. Working REDOP system equations, hardware, and system calibration are discussed; and present and future data reduction processes including the digital computer program are presented along with data samples of the lunar analog reflectivity measurements and theoretical models for various lunar-like terrains.
M.W.R.

N68-23733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF THE APOLLO REENTRY RADAR
James R. Moore Jun. 1967 157 p refs
(NASA-TM-X-63180; X-507-67-281) CFSTI: HC $3.00/MF $0.65 CSCL 17I

In this report a more exacting analysis of the performance of the Apollo acquisition and tracking radar has been made. The coverage of the radar has been expanded to include all possible trajectories which do not exceed 16 g deceleration during the reentry phase. Most of the entering trajectories which develop more than 16 g will also be acquired and tracked. Radar station positions, relative to the entry point and the projected pre-reentry ground track, have been ascertained for optimum radar performance. Optimum down range station location has been derived for entry angles within the specified range of entry angles. The derogatory influence of network tracking errors and ship navigation errors on the performance of the radar has been examined. The placement of the ship in the position for optimum performance of the radar should be given careful consideration in planning and in the execution of ths mission. At least two acquisition messages, in addition to those planned for the network, should be prepared for the ship.
Author

N68-23800# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CORRECTION CODES FOR DATA TRANSMISSION AND PROCESSING
Yu. G. Zarenin 25 Sep. 1967 156 p refs Transl. into ENGLISH of the publ. "Korrektiruyushchiye Kody Dlya Peredachi i Pererabotki Informatsii" Kiev, Izd. Tekhn., 1965 p 1–170
(FTD-HT-23-609-67; AD-667758)

The book considers correcting codes (error-detecting and error-correcting codes) as a universal method which may be used to construct systems which realize any desired conversions of information. The concepts of conversion and the converter are defined; methods of describing these concepts are examined. Three classes of conversions which are most often encountered are identified, - transmission or storage, logical conversion, and arithmetic conversion. Correcting codes for all these classes of transformations are examined. Theoretical capabilities are determined, methods of constructing and evaluating the performance of correcting codes are determined. The book is intended for engineers and technicians working in the field of design and use of digital systems for automation and computing, and also may be useful for students in advanced courses of the corresponding specialties.
TAB

N68-23859# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
TABULATIONS OF VHF PROPAGATION DATA OBTAINED OVER IRREGULAR TERRAIN AT 20, 50, AND 100 MHZ. PART 3: OHIO DATA Technical Report
M. E. Johnson, M. J. Miles, P. L. McQuate, and A. P. Barsis Dec. 1967 533 p refs
(IER-38-ITSA-38-3; AD-667530) GPO: HC $2.50; CFSTI: MF $0.65

The report contains tabulations of transmission loss data resulting from propagation experiments at 20, 50, and 100 MHz conducted over irregular and partly wooded terrain in northeastern Ohio.
Author (TAB)

N68-23883# Ohio State Univ., Columbus. ElectroScience Lab.
MEMORANDUM ON ANALYSIS OF ECHO AREA OF TARGETS USING GEOMETRICAL THEORY OF DIFFRACTION AND CREEPING WAVE THEORY Quarterly Technical Report, 1 Oct.–30 Oct. 1967
Bedford, Mass. Electron. Systems Div. Jan. 1968 18 p refs
(Contract AF 19(628)-67-C-0308)
(ESD-TR-68-153; QTR-2430-3; AD-667799)

The report outlines the progress in the past quarter in developing a computer program for direct scattering calculations.
Author (TAB)

N68-23884# Postmaster-Generals Dept., Melbourne (Australia).
CALCULATION OF THE INTERFERENCE BETWEEN SATELLITE AND TERRESTRIAL RADIO SYSTEMS, 1965–1966
J. Murphy 5 Aug. 1966 24 p refs
(Rept.-6097) CFSTI: HC $3.00/MF $0.65

The report describes the basis and examples of the calculation of mutual interference between satellite and radio repeater systems, which is a necessary step in the coordination of these systems.
Author

N68-23916# Naval Research Lab., Washington, D. C.
ELIMINATING RADAR AMBIGUITIES BY PROCESSING STAGGERED PULSE TRAINS OR SPECTRA Interim Report
H. H. Woerrlein 19 Feb. 1968 43 p ref
(NRL-6651; AD-667455)

A method for reducing or eliminating doppler and/or range ambiguities ordinarily associated with using repetitive waveforms in radar has been developed. The basic idea calls for building two radar systems into one. Two different waveforms are impressed on one carrier, the waveforms being designed in such a fashion that they can be separated and processed in different receiver channels. The combined information of the two processed signals is used to reduce or to eliminate ambiguities. Analog computation has been used to study the feasibility of generating and processing the proposed waveforms. A new method for measuring small frequency shifts is suggested. A pair of pulses is used; the first and the second pulse will produce ringing at the outputs of a first and a second narrowband filter, respectively, and the relative phase of the ringing oscillations is shown to be linearly related to the difference between the carrier frequency and the filter center frequency.
Author (TAB)

N68-23936# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

REENTRY COMMUNICATION STUDIES AND RECENT FLIGHT TEST RESULTS

J. Leon Poirier *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 14 p (See N68-23931 13-34)

Reported are the interaction of microwave radiation with shock ionized flow fields which focus on the development of techniques for mitigating the severely deteriorative effects of the plasma sheath that surrounds aerospace vehicles during reentry. Flight tests aboard four stage Trailblazer II vehicles capable of attaining reentry velocities of 18,000 fps were used to confirm predictions of theoretical analyses and laboratory experiments. Flight tests data on nonlinear pulse distortion and interantenna coupling behavior of a microwave communication system agreed with theory. Two new diagnostic tools, the electroacoustic probe and the flushmounted Langmuir probe which were flown for the first time during flight test experiments yielded valuable data on the electron density profile of the plasma sheath. Author

N68-23954# Stanford Univ., Calif. Dept. of Mathematics.

REFLECTION AND TRANSMISSION OF PLANE WAVES BY LAYERED PERIODIC MEDIA

E. M. de Jager (Twente Inst. of Technol., Enschede, Netherlands) and H. Levine 1 Apr. 1968 21 p refs
(Contract Nonr-225(74))
(TR-12; AD-667598)

The reflection and transmission coefficients (at normal incidence) for plane parallel slabs consisting of N inhomogeneous and exactly duplicated parallel layers are expressed in terms of the corresponding coefficients for a single layer. The analysis is effected by two different methods, one of which stems from the so-called invariant imbedding viewpoint while the other relies on a more conventional matrix argument. Author (TAB)

N68-23961 Aerospace Corp., El Segundo, Calif. Satellite Systems Div.

MILITARY COMMUNICATION SATELLITES, MAY 1962–DECEMBER 1967

Virgil W. Wall Jan. 1968 31 p
(Contract F04695-67-C-0158)
(TR-0158(3111-01)-1; SAMSO-TR-68-116; AD-667782)

Earth-orbiting satellites are a flexible and rapid means of communications, and as such, are extremely valuable to the military. The paper discusses the Initial Defense Communication Satellite Program (IDCSP). In IDCSP, several satellites are launched one at a time into a near synchronous equatorial orbit with a single launch. IDSCP has demonstrated the feasibility of point-to-point communication via satellite between semi-fixed ground terminals. It is the intent of the satellites to implement a world-wide military communication system. The paper describes additions to IDSCP which allow it to be used as a special-purpose satellite by the United Kingdom. A tactical communication satellite, which uses small, moving terminals, is also described. Author (TAB)

N68-24029# Georgia Inst. of Tech., Atlanta.

INTERFERENCE REDUCTION TECHNIQUES EMPLOYING ACTIVE DEVICES Final Technical Report, 1 Dec. 1966–30 Nov. 1967

Hugh W. Denny, Robert A. Byers, Carl R. Driskell, and Charles S. Wilson Griffiss AFB, N. Y. RADC Feb. 1968 95 p refs
(Contract F30602-67-C-0066)
(RADC-TR-68-8; AD-667567)

This report discusses the development and performance of several techniques employing active devices for the reduction of adjacent and co-channel interference in receivers. For operational situations where the interfering source is co-sited with the receiver, an automatic phase control system is described which detects the differential phase shift between the interference path and the direct path from the source and supplies a phase corrected signal for cancellation of the interfering signal. For the more general situation where the interference is not a cosite source, a feed forward system and a dual loop, phase locked system were developed. The dual loop cancellation system generates an auxiliary signal to cancel the interfering signal. The improved performance of passive preselectors that can be obtained through Q multiplication is demonstrated with a Q multiplier device for the UHF region. Active and passive circuit configurations which incorporate the extremely narrow passbands of quartz crystals are discussed. When used as band stop filters, interference rejection levels greater than 50 dB are possible with these filters. Author (TAB)

N68-24051# Harvard Univ., Cambridge, Mass. Cruft Lab.

A METHOD OF OBTAINING THE IMPEDANCE OF AN ANTENNA IN A DISSIPATIVE MEDIUM FROM THAT IN AIR

Keigo Iizuka Feb. 1968 25 p refs
(Contract F19628-68-C-0030)
(AFCRL-68-0049; SR-1; AD-667806)

A Taylor series expansion is applied in the complex frequency plane in order to find the admittance of an antenna in a dissipative medium from the admittance of the same antenna in air. The admittance of a dipole antenna immersed in media with tan delta = 0.01 and 0.02 is tabulated. The values so obtained are in good agreement with measurements. The error and the range of values of the loss tangent of the medium and the length of the antenna for which the present method is applicable are examined from various angles. Author (TAB)

N68-24090 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

TARGET DETECTION ON SIDE-LOOKING RADAR WHEN IMAGE MOTION CAN BE TEMPORARILY DELAYED Final Report, Jan.–Nov. 1966

Almon J. Bate and Herschel C. Self Nov. 1967 35 p refs
(AMRL-TR-67-23; AD-667202)

The study was conducted to determine the effect, on the recognition of targets of opportunity, of permitting subjects to stop and, when behind, speed up the presentation of dynamically displayed, high-resolution, coherent side-looking radar. The radar film was projected onto a 14-inch square, rear-projection screen at a scale of 1:94,000. On the screen, 1-inch displayed approximately 1.29 nautical miles of terrain. The radar imagery moved from the top to the bottom of the screen at a simulated aircraft speed of 2000 Knots in the normal mode and 4000 Knots in the catchup mode. Thirty-eight radar navigator-bombardiers from the Strategic Air Command were randomly assigned to two groups. Subjects in group I were presented the radar imagery at a constant speed of 2000 Knots. Subjects in group II could view the radar imagery at a speed of 2000 Knots, stop the image movement for any length of time they desired up to a total accumulated stop time of 45 seconds and could eliminate any accumulated stop time by speeding up the image movement to 4000 Knots. There was no significant difference between the two groups in number of correct or number of false positive responses; nor was there a significant difference in response latency. These results do not justify providing equipment to stop image motion for the purpose of improving target detection in the presentation of side-looking radar imagery of the quality used in this study. Author (TAB)

N68-24154*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DIGITAL DATA QUALITY MONITOR FOR APPLICATION IN THE NASCOM NETWORK DATA TRANSMISSION SYSTEM

Denver W. Herr and Donald D. Wilson Jun. 1967 27 p
(NASA-TM-X-61062) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Engineering design concepts for a digital data quality monitor (DQM) having applications in the NASCOM network data transmission system are discussed. It is shown that although the equipment engineering design of the DQM which is based on the process of searching for, verifying and locking on a periodic fixed pattern contained in the incoming data and then detecting bit errors in the pattern is not a new technique, the application of this technique to point-to-point data communication service for detecting errors is unique. It is further demonstrated that it is possible to apply this technique to the NASCOM network because the operational data transmitted is formatted into data frames which contain a fixed and periodic pattern for use in obtaining and retaining frame synchronization of the computers. Equipment specifications are given which include descriptions of programable parameters, internal test modes, and the external test mode. Systems applications of the DQM are also discussed. It is concluded that DQM has met all original design requirements, and has proved effective in monitoring the performance of operational high speed data circuits and useful in isolating data circuit segments that have become degraded. Further engineering effort is underway to provide other means of monitoring the quality of live 2400 bit per second digital data traffic. S.C.W.

N68-24155 Aerospace Corp., El Segundo, Calif. Lab. Operations.
MEASUREMENT OF THE COMPLEX DIELECTRIC CONSTANT OF A PLEXIGLAS RADOME AT 5.5-MM WAVELENGTH, JANUARY–DECEMBER 1967
Clarence J. Carter, Richard L. Mitchell, and Earl E. Reber Jan. 1968 23 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-46)-10; SAMSO-TR-68-119; AD-667219)

The report describes the measurements and computations used to determine the complex dielectric constant of a Plexiglas radome in the region of 5.5 mm. The transmission losses were measured as a function of the angle of incidence of the antenna beam at ten frequencies in the range from 53.4 to 56.4 GHz. The measurement data were compared to the theoretical transmissivity to determine the dielectric constant of 2.07 - j 0.012.
Author (TAB)

N68-24178# Center for Naval Analyses, Washington, D. C. Operations Evaluation Group.
COMPARATIVE ACCURACY OF TWO PASSIVE RANGE FINDING SYSTEMS
Hillel Spitz and Mary R. Kenney 5 Mar. 1968 19 p
(Contract N00014-68-A-0091)
(OEG-RC-80; AD-667573)

Evaluation of the relative effectiveness of two passive range finding systems requires the determination of how accurately the length of a side of a triangle can be calculated when the accuracies of measurement of two angles and another side are known. The accuracy achieved using the angles adjacent to the unknown side is compared with that resulting from using the angles adjacent to the known side. Author (TAB)

N68-24183# Parke Mathematical Labs., Inc., Carlisle, Mass.
ON A FAMILY OF ERROR CORRECTING AND SYNCHRONIZABLE CODES Interim Scientific Report
T. Hatcher Feb. 1968 34 p refs
(Contract F19628-67-C-0030)
(AFCRL-68-0092; Rept.-0030-SR-4; SR-4; AD-667802)

Based on the ideas of Neumanns Error Limiting Codes, a family of error correcting synchronizable codes is defined and studied. Examples of these codes are given. Author (TAB)

N68-24198# Sperry Rand Corp., Great Neck, N. Y. Systems Mangement Div.
PICTORIAL SONAR DEMONSTRATION MODEL PROGRAM Final Report, 1 May–30 Nov. 1967
Feb. 1968 65 p refs
(Contract N00014-67-C-0465)
(GJ-2510-1641; AD-667832)

The objective of the program was to test the Pictorial Sonar technique, which employs wide-band sound projection and data processing of target echo returns received on two hydrophones to form the equivalent of a large number of high resolution beams. The program demonstrated the feasibility of the Pictorial Sonar principle for detecting and locating isolated target returns provided that only a small number of angle resolution elements are filled simultaneously. The report describes the Demonstration Model and the tests performed. The experimental results are presented and shown to correspond with the results predicted by the analytic model. A new configuration, which should result in improved Pictorial Sonar performance in a multiple target situation, is presented.
Author (TAB)

N68-24210*# California Univ., Berkeley. Space Sciences Lab.
GAIN MEASUREMENTS OF STANDARD ELECTROMAGNETIC HORNS IN THE κ AND κ_α BANDS Technical Report
Gerard Wrixon Mar. 1968 41 p *Its* Ser. 9, Issue 12
(Grant NsG-243; Contract Nonr-222(54))
(NASA-CR-94608; AD-667840) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Measurements are described in which the gain of the standard horns in the k and k sub alpha bands were determined at a number of frequencies. The two-antenna method was used. It is believed, after a detailed error analysis, that the gain is known to well within plus or minus 0.1 db at each frequency measured. The gain of the k-band horn was also determined at one frequency by numerically integrating the power pattern. This resulted in a gain value which confirmed that obtained using the two antenna method.
Author (TAB)

N68-24224# Syracuse Univ., N. Y. Dept. of Electrical Engineering.
DESIGN AND DEVELOPMENT OF PARTIALLY UNIFORM ARRAYS Final Report, 1 Feb. 1966–31 Jan. 1968
Bradley J. Strait 28 Feb. 1968 67 p refs
(Contract AF 19(628)-5882)
(EE-0268-F; AFCRL-68-0110; AD-667801)

Several methods for designing linear arrays of antennas are summarized. Techniques for treating both equally spaced and unequally spaced arrays are discussed, and it is shown that desirable array pattern characteristics can be designed for and realized without requiring undue complication of either the amplitude distribution or the spacing configuration. The resulting arrays are called partially uniform since considerable uniformity is provided with regard to both the excitation amplitudes and the interelement spacings in order to minimize the realization problems brought about by the adverse effects of mutual coupling. The methods presented here for equally spaced arrays apply to both broadside and endfire conditions and can be used to place pattern nulls in one or more specified directions. These methods have additional advantage in that an equivalence is established with equally spaced arrays allowing determination of the types of results that can be expected when unequal spacings are used as design parameters. Several experimental examples are given. Author (TAB)

N68-24263# Electronic Systems Div., Bedford, Mass.
A GENERAL ANALYSIS OF NATURAL ENVIRONMENTAL EFFECTS ON ELECTROMAGNETIC RADIATION UTILIZED FOR COMMUNICATIONS

Norman E. Gaut and Kenneth E. German Jan. 1968 173 p refs
(ESD-TR-67-631; AD-667193)

The earth and its atmosphere provide a highly complex environment for the propagation of electromagnetic waves. A convenient method to study the interply between this environment and propagating electromagnetic signals is to isolate various quasi-homogeneous regions of the earth-atmosphere system, and study the effects they have on different frequency signals. The troposphere, the ionosphere, the oceans and the solid crust are such quasi-homogeneous subdivisions. This report presents a short review of the physical make-up of each of the subdivisions important to radio propagation, together with the most important effects each has upon the propagation of electromagnetic signals.
Author (TAB)

N68-24298# Lincoln Lab., Mass. Inst. of Tech., Lexington.
HAYSTACK ANTENNA REFLECTOR SURFACE IMPROVEMENT PROGRAM
David G. Stuart 29 Jan. 1968 34 p refs
(Contract AF 19(628)-5167)
(TN-1968-7; ESD-TR-68-8; AD-667518)

A comprehensive program of study and measurement of the Haystack reflector has been conducted, resulting in a performance improvement of approximately 40 percent. A stochastic approach to data taking an analysis combined with the benefits of an on-site computer, provided analytical control of the adjustment operation, and at the same time assured a short reaction time between receipt of the raw data and completion of a detailed analysis of the surface condition. Conventional measurement equipment was used to control the adjustment operation with special attention given to extracting the utmost precision from each device. The rms deviation of the best-fitting paraboloid was reduced from 0.037 to 0.017 inch in the course of the adjustments and corresponding increases in antenna performance have been observed. Author (TAB)

N68-24302# Federal Communications Commission, Washington, D. C. Research Div.
FCC/USAF POPSI PROJECT, ANNEX A
Roger B. Carey, Daniel B. Hutton, and Gary S. Kalagian 15 Mar. 1968 116 p
(R-6801, Annex A; AD-667423)

Contains experimental data in addition to that presented in the main body of the report. TAB

N68-24304# Federal Communications Commission, Washington, D. C. Research Div.
FCC/USAF POPSI PROJECT
Roger B. Carey, Daniel B. Hutton, and Gary S. Kalagian 15 Mar. 1968 140 p refs
(R-6801; AD-667422)

From 15 February 1966 to 16 February 1967, the FCC and USAF, with the cooperation of the U. S. Coast Guard, the FAA, the U. S. Weather Bureau, and NASA, conducted an investigation known as the POPSI (Precipitation and Off-Path Scattered Interference) Project. The investigation involved studies of the scattered signal from precipitation and other mechanisms located in the common volumes established by the intersections of the beams from a transmitting antenna operating in a configuration simulating a satellite earth station, and receiving antennas configured in a manner typical of terrestrial microwave radio relay stations. The project was designed to obtain data at a frequency of 5.75 GHz for a statistical treatment to estimate the magnitude of the problem of both on and off-path scattered interference between microwave radio relay stations and satellite system earth stations sharing the same frequency bands. More than 3000 hours of field strength measurements were recorded. Some attempt has been made to correlate the enhanced fields with meteorological phenomena, although the mechanisms have not been examined in great detail for this report. Author (TAB)

N68-24306# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A DECADE OF RESEARCH IN ELECTROMAGNETIC PHENOMENA UNDER JOINT SERVICES Final Report
Ronold W. P. King Feb. 1968 34 p refs
(Contract Nonr-1866(32); Nonr-1866(16); Nonr-1866(07))
(TR-553; AD-667253)

A summary of research in the broad area of electromagnetic phenomena is reported. The main topics include: antennas; coupled antennas and arrays; electromagnetic waves, media, and obstacles; techniques and tools of measurement; electrohydrodynamic phenomena; and miscellaneous topics. Author (TAB)

N68-24311*# Analytical Mechanics Associates, Westbury, N. Y.
RTCC REQUIREMENTS FOR MISSION G: LANDING SITE DETERMINATION USING ONBOARD OBSERVATIONS, PART 2 Final Report
George A. Austin and Paul Flanagan (NASA Manned Spacecraft Center, Houston, Tex.) Apr. 1968 30 p refs
(Contract NAS9-4036)
(NASA-CR-92124; Rept.-68-5) CFSTI: HC $3.00/MF $0.65 CSCL 09F

During the lunar landing mission, the ground Real-Time Computer Complex will locate the landing site relative to the command module orbit through the use of telemetered CM optical sightings. Also, the lunar module position after landing will be found by using telemetered rendezvous radar tracking of the orbiting CM. Two programs are described, a preprocessor which collects and prepares the telemetered data and the landing site determination program. The description of the latter includes a discussion of the batch initialization, differential correction, and convergence processor modules. The same predictor module used for the MSFN orbit determination processor will be used to determine the CM ephemeris over the landing site. The computation of LM position requires the use of the libration matrix which relates the mean of the nearest Besselian year (MNBY) system to the selenographic coordinate system. Author

N68-24336*# Advanced Technology Corp., Timonium, Md.
STUDY PROGRAM ON (30–100 GHz) ELECTRONICALLY STEERABLE ANTENNA SYSTEMS Quarterly Report, 20 Oct. 1967–20 Jan. 1968
John M. Cotton, Jr. and Dennis E. Grimes 20 Jan. 1968 27 p ref
(Contract NAS5-10256)
(NASA-CR-94686; QR-6) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Summarized are results of experimental studies of feed systems for an envisioned satellite borne electronically steerable antenna system. Reported are results of studies of series and optical feed systems. Utilizing data accumulated from previous experimental studies, three of the series feed arms to be used in the feasibility model were fabricated and preliminary tests were completed; also completed were studies on the design and fabrication of a phase corrected optical feed system. Variable tuning techniques for the series feed section and design concepts for the lensed illuminating horn and the compensated receiving array of the optical feed system are described. S.C.W.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-23109# Gulf General Atomic, San Diego, Calif.
GRAFIX: A COMPUTER PROGRAM FOR THE VISUAL DISPLAY OF ENGINEERING DATA
D. A. Doering 13 Nov. 1967 100 p refs
(Contract AT(04-3)-167)
(GAMD-8362) CFSTI: HC $3.00/MF $0.65

GRAFIX is a general-purpose Univac 1108 computer plot code. The code uses the GA Plot Package and RITE Package to generate a Stromberg Carlson SC-4020 CRT plotter control tape for off-line processing. It is designed to give the user considerable flexibility and ease in preparing customary engineering graphs and figures of reasonably high quality from data stored on card, tape, or drum. By option control, the user can vary the size and type of scales, grids, and titles; plot symbols; draw solid or dashed curves with or without arrow heads; label individual curves; overlay plots; annotate; draw figures; and subdivide a given frame into subframes to generate larger plots in sections. Processing time is less than 2 seconds per frame. Author (NSA)

N68-23179# Oak Ridge National Lab., Tenn. General Engineering Div.
DECIDE: A COMPUTER SOLUTION OF PROBABILISTIC NETWORKS TO AID DECISION MAKING INVOLVING UNCERTAINTY
F. T. Snyder, W. C. Stoddart, and P. E. Scott Jan. 1968 46 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2096) CFSTI: HC $3.00/MF $0.65

Decision Evaluation Control Involving Doubtful Elements (DECIDE) is a computer program developed to analyze a network containing activities that occur probabilistically as well as those that occur with certainty and to predict outcomes in terms of probable occurrence, time, and cost. This systematic method of evaluating risk and uncertainty in research and development projects is intended to aid decision makers in evaluating the effects of uncertainties in determining the level of risk involved in a new project. A network plan is prepared to show the sequence of activities and the alternative courses and/or time and cost that are available or that may be required at decision points. A probability of occurrence value is assigned to each alternative action and the network is solved for probable values of terminal points. With these values, the merit of a proposed project can be determined, and this determination will recognize the possible effects of interrelated variables upon the success of the project. The DECIDE program can be applied to many areas such as the planning of projects and experiments, evaluation of projects and costs, and the analysis of processes. Author (NSA)

N68-23208# California Univ., Berkeley. Lawrence Radiation Lab.
ERROR CHECKING AND OTHER ASPECTS OF DATA LINK ORGANIZATION
Robert W. Lafore 8 Nov. 1967 6 p Presented at the Fall Digital Equipment Computer Users' Soc. Symp., Anaheim, Calif., 10–11 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17934; CONF-671123-2) CFSTI: HC $3.00/MF $0.65

The arrangement of registers in the data link permits error detection and correction and solves the problem of synchronizing the computers at the ends of the line. Preliminary information must be exchanged between the two synchronizers before a data record may be sent. The approach to the logic design of the system is also briefly described. Author (NSA)

N68-23218 Stanford Univ., Calif.
AN APPROACH TO COMPUTER SPEECH RECOGNITION BY DIRECT ANALYSIS OF THE SPEECH WAVE
Dabbala Rajagopal Reddy (Ph.D. Thesis) 1966 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4420

We have developed a system for obtaining a phonemic transcription from a speech sample entered into the computer by a microphone and an analog to digital converter. Correct identification of most speech sounds was achieved for a single co-operative speaker. We discuss in Chapter 2 the requirements of a useable computer system for speech research, its input–output configuration, and the design of a suitable man-machine communication system. In Chapter 3 we describe how the program divides a two-second speech utterance into segments approximately corresponding to phonemes, determines the pitch of those segments, where pitch analysis is appropriate, and computes a list of parameters for each segment that is later used to assign phonemic values. In Chapter 4 we explain how phonemes are associated with segments of speech. Chapter 5 contains the results of the classification of 32 sounds of 1 to 2 seconds duration, and error analyses. Dissert. Abstr.

N68-23219# Case Western Reserve Univ., Cleveland, Ohio. Systems Theory Group.
LEARNING THROUGH PATTERN RECOGNITION APPLIED TO A CLASS OF GAMES
Elliot B. Koffman Jun. 1967 156 p refs
(Grants AFOSR-125-67; NSF GK-185)
(SRC-107-A-67-45; AFOSR-68-0514; AD-666673)

The objective of this research was to investigate a technique for machine learning useful in solving problems involving forcing states. In games or control problems, a forcing state is a state from which the final goal can always be reached, regardless of what disturbances may arise. A program which learns forcing states in a class of games (in a game-indepndent format) by working backwards from a previous loss has been written. The class of positions which ultimately results in the opponents win is learned by the program (using a specially designed description language) and stored in its memory together with the correct move to be made when this pattern reoccurs. During future plays of the game, these patterns are searched for. If they are formed by the opponent, the learning program blocks them before the opponents win sequence can begin. If they are formed by the learning program, it initiates the win sequence. The class of games in which the program is effective includes Qubic, Go-Moku, Hex, and the Shannon Network Games including Bridg-it. The description language enables the learning program to generalize from one example of a forcing state to all other configurations which are strategically equivalent. Author (TAB)

N68-23229 Stanford Univ., Calif.
AN APPROACH TO COMPUTER LANGUAGE DESIGN
William Marshall McKeeman (Ph.D. Thesis) 1966 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4402

A *kernel programming language* includes those constructs universally applicable to the problem of computer control. The need for constructs outside the kernel leads to the concept of an *extendable compiler*. We approach this problem by attempting to simplify the methods of generating a compiler and by designing a basic language upon which to build. The form of a language is determined by its grammar. In particular, we demand a context free grammar as the initial input to a syntax preprocessor which produces syntactic analysis tables for the extendable compiler. The methods are extensions of the precedence grammars of Floyd and Wirth–Weber. A formal mathematical description of a class of analysis algorithms including the above is given and two new syntax preprocessor algorithms are presented. Some theorems concerning the behavior of the algorithms and the nature of the acceptable grammars are given. Dissert. Abstr.

N68-23234# Illinois Univ., Urbana. Dept. of Computer Science.
THE WEB SYSTEM. PART 2: A FORMAL DESCRIPTION OF THE WEB INPUT LANGUAGE
W. D. Bond, E. S. Davidson, and B. H. McCormick 19 Jun. 1967 22 p ref
(Contract AT(11-1)-1018)
(COO-1018-1118; Rept.-232) CFSTI: HC $3.00/MF $0.65

The input language for the WEB design automation system is described. The WEB input consists of a logic description, housing description, module description, and an assignment description. The syntax of the WEB language is included. NSA

N68-23259# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ON MAN-COMPUTER INTERACTION: A MODEL AND SOME RELATED ISSUES
Jaime R. Carbonell 15 Sep. 1967 42 p refs
(Contract F19628-68-C-0125; ARPA Order 627)
(BBN-1593; AFCRL-68-0053; SR-1; AD-666666)

A survey of the literature related to man-computer interaction reveals the many aspects of this problem, which appears to be in the crossroads among such diverse fields as computer languages, computer systems operational characteristics, control theory, decision theory, information theory, applied psychology, computer display and interface engineering, etc. In this paper we have chosen to present the on-line interaction from an information and decision point of view. A model is given of the case in which a human operator is engaged on-line in the solution of a problem like debugging a program, testing a model in a scientific application, or performing a library search. In this model the human operator is considered to seek to minimize overall cost. This cost is obtained by adding the operational cost of both man and computer to a remnant terminal cost originated by the remaining uncertainty. This analysis, performed for each of a set of possible alternatives for action, may lead to select and execute one of them, to terminate the process, or to re-evaluate the possible alternatives and/or hypotheses in a search for new ones. Some practical applications in terms of response time and other characteristics of a computer utility are presented, as well as some theoretical implications from an informational point of view. Author (TAB)

N68-23273# Duke Univ., Durham, N. C. Medical Center.
THE STATISTICAL AND COMPUTATIONAL ANALYSIS OF A SIMPLE LEARNING PROGRAM Final Technical Report
Max A. Woodbury 1 Mar. 1967 38 p refs
(Grant AF-AFOSR-1180-66)
(AFOSR-68-0505; AD-666932)

A scheme for making an adaptive predictor was based upon a variable linear combination of a large number of non-linear functions of the available predicting variables generated by the use of a pseudo-random numbers. This allowed a regeneration of the predictors computationally each time they were needed rather than relying on massive storage. Thus a small fast computer could be used in lieu of one with a large memory. The elementary analysis of the statistical properties of the perceptron-like program (suggested by the random nature of the predictor generator) was undertaken and tested numerically with results which partially confirmed the analysis. Further statistical investigations of the process were then undertaken. The results of these indicate the efficiency of the predictor is quite good in some cases and relatively poor in others. This lead the way to later analysis to explore schemes which improve upon perceptron-like predictors in those cases where the predictor efficiency is poor. These results will be reported on elsewhere. Author (TAB)

N68-23274# Union Carbide Nuclear Co., Oak Ridge, Tenn.
A BASIC LANGUAGE COMPUTER PROGRAM FOR CALCULATING INTERPLANAR SPACINGS
P. R. Budelov and J. R. Cullipher 15 Feb. 1968 24 p refs
(Contract W-7405-ENG-26)
(Y-1603)

A computer program has been developed for calculating the interplanar spacings (d, A) of a crystal, given the crystal system and the lattice parameters. The program, written in the BASIC computer language, generates and prints only valid Miller indices and interplanar spacings for the crystal system specified. Author

N68-23282# Illinois Univ., Urbana. Dept. of Computer Science.
AN INPUT-OUTPUT SYSTEM FOR A MULTIPROGRAMMED COMPUTER
Gerald N. Cederquist (M.S. Thesis—Jun. 1967) 24 Apr. 1967 88 p refs
(Contract AT(11-1)-1018)
(COO-1018-1111; Rept.-223) CFSTI: HC $3.00/MF $0.65

Design specifications for a parallel input-output system for a multiprogrammed computer are presented. The system performs asynchronous time-division multiplexing of information transfers between a fast memory and a group of fast, synchronous input-output devices, allowing as many as eight input-output programs to execute simultaneously. NSA

N68-23283# Illinois Univ., Urbana. Dept. of Computer Science.
A GRAPHICS DISPLAY LANGUAGE
Dugald Austin Henderson, Jr. (M.S. Thesis) 21 Aug. 1967 136 p ref
(Contract AT(11-1)-1469)
(COO-1469-0068; Rept.-240) CFSTI: HC $3.00/MF $0.65

A tentative language giving the ability to describe and produce planar figures composed of straight line segments and circle arcs is described. Two computer programs, both called HANDLER, which utilize this language are given. NSA

N68-23297# Tracor, Inc., Austin, Tex.
THE USE OF CONCEPTUAL RELATIONS IN CONTENT ANALYSIS AND DATA BASE STORAGE
Roger C. Schank Jan. 1968 57 p refs
(TRACOR-68-347-U; AD-666992)

Machines that may be said to function intelligently must be able to understand questions posed in natural language. Since natural language may be assumed to have an underlying conceptual structure, it is desirable to have the machine structure its own experience, both linguistic and nonlinguistic, in a manner concomitant with the human method for doing so. This paper presents some attempts at organizing the machines information store conceptually. The attempts are discussed and coordinated into a framework for what may be a practicable system. Author (TAB)

N68-23327# Rock Island Arsenal Lab., Ill. Weapons Operations Research Office.
A GENERAL FORTRAN PROGRAM FOR LEAST-SQUARES ANALYSIS OF VARIANCE
Stuart Olson Jan. 1968 36 p refs
(OR-68-1; AD-666748)

The report describes a computer program written in FORTRAN language designed to be used for the majority of least-squares analysis of variance computations. The program is completely general in the sense of its ability to handle any size of factorial-type of design. A users control card sets the number of factors, k, and the maximum number of levels per factor. Interaction sums of squares may be obtained to a maximum depth of k-1. In computing the sums of squares for a category of variance, the number of observations are counted concurrently with the summing of them. This allows for analysis of experiments with missing data and for unbalanced designs in which no observations may exist at certain levels of some factors without the need for artificial techniques for estimating

the missing data. The program consists of three main parts: initialization and input of observations, computations of raw (uncorrected) sums of squares, and correction of raw sums of squares and output. The user is required to write his own input subroutine which interfaces the users input card file with observation storage of the main program. Author (TAB)

N68-23340# New York Univ., N. Y. AEC Computing and Applied Mathematics Center.
A SYNTAX-DIRECTED FORTRAN STATEMENT CHECKER
Susan S. Hoffberg and Max Goldstein Jan. 1968 54 p refs
(Contract AT(30-1)-1480)
(NYO-1480-85) CFSTI: HC $3.00/MF $0.65

A syntax checking program for analyzing a given line of FORTRAN coding for grammatical correctness is described. Included are the flow diagrams, the syntax specification table, and a listing of the code for the syntax checker. NSA

N68-23348# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A PROPOSED ANALOG TO DIGITAL CONVERTER FOR SMALL EARTH SATELLITES
J. C. Loessi Oct. 1967 64 p refs
(Contract NOw-62-0604-c)
(APL-TG-954; AD-666811)

This proposal describes an analog to digital converter suitable for use in small earth orbiting satellites. The theory of operation is also discussed. Some of the advantages of this converter are that (a) for the most part it can be constructed from available integrated circuits, (b) it is small in size and consumes less power than A/D converters of other types, and (c) the design requires no parts with light tolerances and is free from errors due to drift. It is proposed that this analog to digital converter be used in the X-Ray Explorer Satellite and in the Navy Navigation Satellite programs. Author (TAB)

N68-23388 Northwestern Univ., Evanston, Ill.
ASSOCIATIVE MEMORY SYSTEMS AND THEIR APPLICATIONS TO PICTURE AND ARITHMETIC PROCESSINGS
Chao Chih Yang (Ph.D. Thesis) 1966 83 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-4283

Two different associative memory systems implemented by cryotrons and cutpoint cells are presented. The cutpoint cellular associative memory designed on the basis of stage delay analysis does not use any ladder structure, but employs a high-speed controlled shift register for the sequential tagging of all matched memory words. Both systems are so mechanized that their structures are simple and especially compatible with the batch fabrication of integrated circuits. Moreover, both systems can perform ordered information retrieval following Lewis's sorting scheme, template-matching pattern recognition based on the union-intersection concept and nonbulk two-summand additions of signed binary numbers in the signed-2's-complement number system. The basic operations of each system include comparison, reading, writing, sensing and output-summing processes being all performed on the basis of parallel-by-bit. Dissert. Abstr.

N68-23402# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS, NUMBER 15
Wade B. Holland, ed. Mar. 1968 73 p refs
(P-3600/15; AD-666654)

The document reviews recent Soviet activity in computing technology and cybernetics. TAB

N68-23465*# Radio Corp. of America, Princeton, N. J. RCA Labs.
A LOW DRIVE MATERIAL FOR MONOLITHIC FERRITE MEMORIES
C. Wentworth and Robbi [1968] 30 p refs
(Contract NASw-979)
(NASA-CR-94584) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The various steps involved in fabricating a low drive laminated ferrite memory plane are described in detail. These steps include ferrite powder preparation, ferrite slurry preparation, ferrite sheet manufacture, conductive line fabrication, laminating, and firing. The desired material properties for the low drive monolithic ferrite include low coercive force, fine grain size, high electrical resistivity, fast switching speed, and temperature stability. Fine grain size ferrites of the magnesium–manganese–zinc variety were selected. The effects of grinding time and calcining temperature on magnetic parameters and the shape of the hysteresis loop of the materials are discussed along with the effects of variables in the processing of the binder system. Also discussed are the composition of the ferrites chosen to give the best match with the desired magnetic and electrical parameters, and the operation of the low drive monolithic memory array. R.N.A.

N68-23504 California Univ., Los Angeles.
SCAN LIMITED AUTOMATA AND CONTEXT LIMITED GRAMMARS
Thomas Nathaniel Hibbard (Ph.D. Thesis) 1966 172 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-538

Context free languages are characterized in terms of scan limited automata and in terms of context limited grammars. A scan limited automaton is a Turing machine which can only write d times in any given square where d is fixed for the automaton. A context limited grammar is a grammar in which context dependency is limited by a partial ordering on the alphabet. The main advantage of these characterizations of the family of context free languages is an extension of the family of deterministic context free languages. The hierarchy of families of d-deterministic languages is defined, and it is shown that this hierarchy is not exhausted at any finite d. It is shown that languages which are deterministic in the sense of push-down automata are 2-deterministic. It is shown that when unambiguity is defined in the natural way for scan limited automata and for context limited grammars, an unambiguous automaton or grammar defines a language which is unambiguous in the usual sense. Dissert. Abstr.

N68-23574# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ON THE MEMORY OF FINITE STATE MACHINES
Kasivisvanathan Vairavan (Ph.D. Thesis) 7 Apr. 1968 93 p refs
(Grant NSF GP-2547)
(EE-683)

The memory structure of finite state machines has been examined and necessary and sufficient conditions for a finite state machine to have finite memory have been obtained. The correspondence between finite memory machines and functions that represent their output has been examined and the class of finite memory machines for which this correspondence is unique and one–one is identified and enumerated. Further two subclasses of finite memory machines for which the above correspondence is not unique and one–one are enumerated. It is shown that a binary nondegenerate finite state machine cannot have both finite (and non-zero) input-memory and output-memory. It is shown that all minimal linear finite state machines are initial state observable. Also it is shown that every n-state minimal binary linear finite state machine has memory $\mu = \log_2 n$, where n is a power of 2. This result yields a simple enumeration of the class of distinct minimal

binary non-degenerate (single input-single output) linear finite state machines. This class has been subdivided into useful sub-classes as finite input-memory, finite output-memory and Moore (state-determined output) machines. Author

N68-23617 European Organization for Nuclear Research, Geneva (Switzerland). Data Handling Div.
THE HPD MARK 2 FLYING-SPOT DIGITIZER AT CERN
M. Benot, B. W. Evershed, R. Messerli, and B. W. Powell 6 Feb. 1968 88 p refs
(CERN-68-4)

Design and operating details are provided on the Hough–Powell device (HPD) which consists of optical, mechanical and electronic parts for scanning bubble chamber photographs by a small spot of light. The HPD is based on the premise that a mechanically generated spot which sweeps repeatedly along a straight line can be used to generate precise coordinates of bubble images. The on-line CDC 6600 computer program controls the main steps in operating the device; thus, the computer instructions specify when and by how many frames the film should be advanced, at which coordinate of the stage the measuring sequence should begin, and at which coordinate it should end. Computer–device–operator interfaces are discussed, and system test programs are described. Data analyses confirm the precision of the measurements. Findings show that tracks reconstructed in three dimensions using the THRESH program give residuals from the best fitted curve for the average points of typically 5 microns rms in the film plane; for tracks of lower moments, the scatter is greater due to the effects of energy loss. M.G.J.

N68-23722*# Raytheon Co., Sudbury, Mass. Space and Information Systems Div.
AUXILIARY MEMORY FOR APOLLO GUIDANCE COMPUTER, VOLUME 1 Final Report
11 Mar. 1968 194 p
(Contract NAS9-5994)
(NASA-CR-92107; R68-4125, V. 1) CFSTI: HC $3.00/MF $0.65
CSCL 09B

Unit description, system organization, software control, and demonstration tests are considered for the auxiliary memory for the Apollo Guidance Computer (AGC). Logic, memory system, and power supply are detailed for the auxiliary core memory; and electrical and mechanical descriptions are given for the interface module, auxiliary tape memory, and control panel. Memory address assignment, address detection logic, and data transfer are described for the AGC memory extension; and tape operations as well as alarms and failure protection are discussed. Control of the auxiliary core memory and the auxiliary tape memory are described; and power control, program tape, data tape, and restart tests are summarized. An interface definition for the auxiliary core and tape memories is given, interface signal routing is discussed, and tape initialization and program tape preparation are considered along with the capabilities of the utility verb. The information which is displayed and the identification information used by the tape transfer subroutine is listed. M.W.R.

N68-23756 Illinois Univ., Urbana. Dept. of Computer Science.
IMPLEMENTATION OF A FAST DIRECT SOLUTION OF POISSON'S EQUATION USING FOURIER ANALYSIS ON ILLIAC 4
Jacques LaFrance 29 Nov. 1967 34 p *Its* ILLIAC 4 Doc. No. 166

An analysis is presented, and assembly code and high-level language implementations of a method developed for the solution of Poisson's equation for a 48×48 grid of points are given. Author

N68-23758# Stanford Research Inst., Menlo Park, Calif.
LOGIC DESIGN TECHNIQUES FOR PROPAGATION LIMITED NETWORKS Final Report, 15 Jul. 1966–14 Oct. 1967
Jacob Goldberg, Milton W. Green, William H. Kautz, Karl N. Levitt, Marshall C. Pease et al Nov. 1967 181 p refs
(Contract AF 19(628)-5920)
(AFCRL-68-0002; AD-667553)

Computationally efficient algorithms are presented for the clustering of the gates of an arbitrary network into pin-limited modules for minimum worst-cast network delay, assuming all delays are at module interfaces. Algorithms are presented for optimally locating clock-distribution terminals on a clock network having uncertain delays proportional to distance. The design of an economical signal-switching network is presented which, starting from the clear state, allows new arbitrary input/output terminal pairings to be made in arbitrary order. Another signal-switching network is described that permits an order-preserving transfer of a block of data among a set of fan-out-limited terminals with the minimum number of intermediate steps; an application is given to the block-transfer of data in a multiple-memory system. Several problems in the design and analysis of asynchronous sequential networks are examined, including the design of totally-sequential networks, given synchronously-derived specifications, the use of matrix-algebraic methods for NOR-element networks, consideration of the effect of input-delays in NOR-element asynchronous nets, and schemes for initializing controlled-logic networks, with and without loops. Author (TAB)

N68-23771*# Raytheon Co., Sudbury, Mass. Space and Information Systems Div.
AUXILIARY MEMORY FOR APOLLO GUIDANCE COMPUTER, VOLUME 2: APPENDICES D AND E Final Report
11 Mar. 1968 272 p
(Contract NAS9-5994)
(NASA-CR-92108; R68-4125, V. 2) CFSTI: HC $3.00/MF $0.65
CSCL 09B

Program listings and the auxiliary core memory signal dictionary are presented for the Apollo Guidance Computer. This includes the printout for the auxiliary memory demonstration and an alphabetical listing of all the instructions for computer implementation. M.W.R.

N68-23803# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGISTER ON UNITRONS [REGISTR NA UNITRONAKH]
A. N. Karmazinskiy, A. Sh. Kheyfets, B. V. Malin, and M. S. Sonin 13 Sep. 1967 18 p refs Transl. into ENGLISH from Poluprov. Pribory i Ikh Primeneniye. Sb. Statey, no. 14, 1965 p 196–210
(FTD-HT-23-706-67; AD-667750)

A shift register based on flip-flops consisting of d-c-coupled field-effect transistors is described. Two variants, differing only in the reset circuits for each flip-flop, were tested. The two reset variants are shown. Author (TAB)

N68-23872# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MULTIPLEXER CODES FOR THE PDP-7
N. P. Wilburn Feb. 1968 91 p refs
(Contract AT(45-1)-1830)
(BNWL-597) CFSTI: HC $3.00/MF $0.65

A small digital computer (PDP-7) has been interfaced to a lowspeed relay multiplexer (2000 points/sec) and a high-speed solid-state multiplexer (240,000 points/sec). The three codes which have been written to operate these multiplexers and to record the data collected onto magnetic tape, are described. Author (NSA)

N68-23932# Illinois Univ., Urbana.
PRINCIPLES AND APPLICATIONS OF THE PLASMA DISPLAY PANEL
D. L. Bitzer and H. G. Slottow *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 43 p refs (See N68-23931 13-34)
(Contracts DAAB07-67-C-0199; Narr-3985(08))

Operating principles of the plasma display panel technique, and applications of the technique in the display of digital information in large scale computer memories and in the development of a flat panel television system are discussed. S.C.W.

N68-23948*# Webster Research Corp., Silver Spring, Md.
OGO SPACECRAFT DATA AND STATUS DISPLAY SOFTWARE SYSTEM
Charles Webster Jan. 1968 33 p
(Contract NAS5-10582)
(NASA-CR-94581) CSCL 09B

General information regarding the overall system requirements and contract work is presented. An implementation schedule has been made to correlate various system activities and work phases, and estimates have been written which define the portions of subsystems that constitute immediate requirements. These descriptions consists of the computer programs which will successfully operate cathode ray tube displays and do the monitoring functions of data input and handling. The cathode ray tube display subsystem, included in the form of an attachment, affords a proposed approach for the design and operation of the CRT real-time processor programs. Detailed descriptions, parameters, operating philosophy, and output formats are included. Author

N68-23985# Stanford Univ., Calif.
TWO NEW PSEUDO-TERNARY CODES
U. Henriksson and I. Ingemarsson Paris ESRO Sep. 1967 34 p refs Sponsored by ESRO
(ESRO-TN-6) CFSTI: HC $3.00/MF $0.65

A coder–decoder system for two pseudo-ternary codes is described. The coder is similar to that for ordinary binary code. The decoding is accomplished by transforming the pseudo-ternary code into Gray-code, which can be decoded in a conventional way. The properties of the two codes are analyzed. One of the codes is similar to the bipolar code, but it has about twice as many words for the same number of digits per word. The other code has a narrow power spectrum similar to that of Lender's duobinary code, but, again, it has about twice as many words. The system is compared with other PCM systems with respect to complexity, bandwidth requirement, and noise immunity. The code properties are such that it is possible to obtain self-synchronization. Conversion to error-detecting codes is easily done. This decreases the number of words to be equal to that of an ordinary binary code. Author (ESRO)

N68-24087 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTER TECHNIQUES
A. M. Oranskiy 10 Oct. 1967 198 p refs Transl. into ENGLISH of the publ. "Vychislitel'naya Tekhnia" Minsk, Izd. Nauka i Tekhn., 1964 p 1–197
(FTD-HT-23-644-67; AD-667646)

Contents: Some questions of computer engineering theory; Elements and devices for digital computers; and Analog computer devices and their application. TAB

N68-24105# Fort Detrick, Frederick, Md.
THE DOT-PLOT COMPUTER PROGRAM
William J. Wiswesser *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 103–116 (See N68-24094 13-34)

An oral presentation that required 20 minutes showed what a line printer can do in less than 2 minutes when directed by a standard computer with a "Dot-Plot" program that uses a rectangular grid in which plotting positions are visible as holes or dots on punched cards. The grid is scanned in exactly the same way as a TV picture. Five different ways of labeling dot-plots of the alkanes are illustrated; and single dot-plots were used for a numerical analysis of benzene-ring isomerism for which the more than 828 different kinds of substituting patterns were "gang-punched" from a single dot-plot setting that provided for any symbol or none at each of the six substituting places. Other applications of dot-plots are discussed. M.W.R.

N68-24106# Army Edgewood Arsenal, Md. Industry Liaison Office.
UPDATING PROGRAM FOR THE INDUSTRY LIAISON OFFICE
David E. Renard *In its* Wiswesser Line Notation Meeting Jan. 1968 p 117–119 refs (See N68-24094 13-34)

Mention is made of the use and updating of an index of permuted Wiswesser line notations for a file of more than 100,000 chemical structures. Chemical structures donated by industries and research laboratories to the government-sponsored file do not have commercial designations, and a computer program permits both the entry of new compounds and the recording of duplicate entries. It is concluded that for a large and continually growing structure file, the Wiswesser line notation provides a highly efficient method for updating without cluttering the file with duplication. M.W.R.

N68-24118# Freiburg Univ. (West Germany). Physikalisches Institut.
CONSTRUCTION AND PROGRAMMING OF AN AUTOMATED LABORATORY MEASUREMENT SYSTEM USING AN ON-LINE COMPUTER [AUFBAU UND PROGRAMMIERUNG EINES PROZESSRECHNERS ALS AUTOMATISCHES LABOR-MESSSYSTEM]
J. Meissburger and Ch. Schlier Jan. 1968 81 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBW-68-02) CFSTI: HC $3.00

The use of a small on-line computer in automated laboratory experiments is described. Discussed are the advantages of computers compared to special automata, optimization with regard to the structure of interface and computer, the treatment of noisy analog channels, and the time structure of measurements. An automated system built with a PDP 8 computer and its use in four different experiments is described. Author

N68-24126# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
USERS' GUIDE TO THE CULHAM COMPUTER GRAPHICAL OUTPUT SYSTEM
F. M. Larkin Dec. 1967 36 p refs
(CLM-R-84) HMSO: 4s 6d

Basic facilities available in the Culham Laboratory standard graphical computer output system (GHOST) are described, and their practical use is explained. Author

N68-24199# National Physical Lab., Teddington (England). Mathematics Div.
USERS GUIDE TO THE NPL GRAPHICAL OUTPUT SYSTEM
B. R. Heap and C. W. Nott Mar. 1968 86 p
(NPL-Ma-63) CFSTI: HC $3.00/MF $0.65

A number of schemes have been produced to enable programmers to make use of graphical output peripherals on the

DKF9 computer. The NPL scheme described in this paper is closely modelled on the GHOST scheme and, in fact, the names and parameter lists of the corresponding ALGOL and FORTRAN procedures are identical. A list of the routines, together with a brief description of their effects, is reviewed. Numerous examples are given in the text, the scheme itself having been used to draw all the diagrams. The GHOST scheme allows several graphical devices to be operated simultaneously. The NPL scheme also incorporates this mechanism but this will not be apparent to the user at present. Author (ESRO)

N68-24221 Naval Weapons Lab., Dahlgren, Va. Ballistic Sciences Branch.
A STRETCH COMPUTER PROGRAM TO CONVERT AND PLOT REVISED HERO RESEARCH DATA
Martha M. Moore Mar. 1968 79 p
(NWL-TR-2139; AD-667835)

A detailed description is given for an IBM 7030 computer program designed to graphically display HERO data obtained during research tests. The tests are conducted using a revised HERO testing procedure in which the aircraft is towed along a radius or an arc of a polar coordinate system. Flow diagrams, FORTRAN IV listings, and samples of input and output are also included. Author (TAB)

N68-24225# Carnegie Inst. of Tech., Pittsburgh, Pa.
TIME SHARING. PART 1: THE FUNDAMENTALS OF TIME SHARING. PART 2: AN EVALUATION OF COMMERCIAL TIME SHARING COMPUTERS. PART 3: OPERATIONAL MANAGEMENT OF TIME SHARING SYSTEMS
C. Gordon Bell, M. M. Gold (MIT), A. C. Steadry (MIT), Richard R. Linde (System Develop. Corp.), and Paul E. Chaney (System Develop. Corp.) 1967 130 p refs
(Contracts Nonr-760(24); ARPA SD-146)
(AD-666730) CFSTI: HC $3.00/MF $0.65

Contents: The fundamentals of time sharing; An evaluation of commercial time sharing computers; Operational management of time sharing systems. TAB

N68-24240 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
CLEBSCH-GORDAN COEFFICIENTS PROGRAM FOR THE ODRA 1003 COMPUTER [WSPOLCZYNNIKI CLEBSCHA-GORDANA PROGRAM DLA MASZYNY ODRA 1003]
A. Gonsior Jan. 1968 19 p refs In POLISH
(INP-559/PL) CFSTI: $3.00

Presented are subroutine descriptions, programmer's instructions, examples of applications, and printouts of a program for computing the Clebsch–Gordan coefficients on the ODRA 1003 computer. K.W.

N68-24241 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
THE CALCULATIONS AN ANGLE FROM THE LAB-SYSTEM FOR AN ANGLE IN THE CM-SYSTEM AND THE CONTRARY CALCULATIONS. THE PROGRAMS FOR THE COMPUTER UMC-1 WITH THE FUNDAMENTAL PROGRAM K-1 [PRZELICZENIE KATA Z UKLADU LABORATORYJNEGO NA KAT W UKLADZIE CENTRUM MAS ORAZ PRZELICZENIE ODWROTNE. PROGRAMY DLA MASZYNY CYFROWEJ UMC-1 PRZY PROGRAMIE PODSTAWOWYM K-1]
Stanislawa Jelonek 1967 25 p In POLISH; ENGLISH summary
(INP-565/PL) CFSTI: $3.00

Three programs are briefly described in this paper. The first program converts an angle from the laboratory (LAB) system to an angle in the center mass (CM) system. The second program does the same calculations and additionally takes $\sin^4 0.5\,\theta_{CM}$ into account. The third program converts an angle from the CM system to an angle in the LAB system. K.W.

N68-24247# California Univ., Los Angeles. Dept. of Engineering.
A SYSTEM FOR COMPUTER-AIDED SELECTION AND ASSIGNMENT OF ELECTRONIC MODULES
Kim. P. Gostelow Mar. 1968 104 p refs
(Contracts Nonr-233(53); AT(11-1)-GEN-10; ARPA SD-184)
(Rept.-68-8; AD-667260)

Describes the implementation of the Component Division and Placement Module of a Design Automation System. The module accepts as input the equivalent of a logic diagram with designer specification of a class of possible logic devices to which each logic element on the diagram belongs. One must also specify the physical characteristics of the electronic devices, the number and type of each device, and the packaging system to be used. The devices on the logic diagram are then assigned to the physical hardware available. Additional designer specifications such as logical grouping have been implemented, and the characterization of board assignment has been generalized. Author (TAB)

N68-24258*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ON PATTERN CLASSIFICATION ALGORITHMS: INTRODUCTION AND SURVEY
Yu-chi Ho and Ashok K. Agrawala Mar. 1968 52 p refs
(Grant NGR-22-007-068; Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(NASA-CR-94610; TR-557; AD-667728) CFSTI: HC $3.00/MF $0.65 CSCL 06D

This paper attempts to lay bare the underlying ideas used in various pattern classification algorithms reported in the literature. It is shown that these algorithms can be classified according to the type of input information required and that the techniques of estimation, decision, and optimization theory can be used to effectively derive known as well as new results. Author (TAB)

N68-24261# Illinois Univ., Urbana. Dept. of Computer Science.
SYNTAX AND SEMANTIC SPECIFICATIONS FOR A HIGH LEVEL LANGUAGE ON ILLIAC 4
Paul Budnik, Yoichi Muraoka, and Bob Wilhelmson 28 Sep. 1967 34 p
(ILLIAC-IV-158)

The first specification of the syntax and semantics for a high level ILLIAC IV language (-SIM) are presented, and the difficulties in its implementation are noted. The revised Algol 60 report was incorporated in this language, and additional productions were added to permit the specification of parallel procedures to take advantage of the parallel structure of the computer. The definition of -SIM is strictly logical, and all the operations done under simultaneous control will have results that are independent of each other. Symbols and standard functions are given for the program; and syntax and semantics are given for the type declaration, structure, and storage allocation. Statements are included for the sequential and simultaneous control, conditional branching, and nesting FOR statements. Also included are the basic set operations, array operators, arithmetic expressions, Boolean expression, conditional statement, block structure, label, and procedure. M.W.R.

N68-24269# Aerospace Corp., El Segundo, Calif. Technical Operations.
PROGRAM-WRITING PROGRAMS: EXTENDING FORTRAN BY PRECOMPILERS, SEPTEMBER 1966–DECEMBER 1967
H. J. Wertz Feb. 1968 22 p ref
(Contract F04695-67-C-0158)
(TR-0158(3307-02)-6; SAMSO-TR-68-147; AD-667536)

The usual method of dealing with frequently encountered computational problems is to write a large special-purpose program. Generally it turns out that flexibility is achieved at the expense of considerable clerical work being required by every user and, further,

that there is never quite enough flexibility, so that continual reprogramming is necessary. Suggested and discussed is the use of precompilers, which, in effect, create a special-purpose program for each particular task. Experience has shown that even users not too familiar with FORTRAN can make efficient use of such precompilers to generate special-purpose programs of their own. Author (TAB)

N68-24309*# Analytical Mechanics Associates, Westbury, N. Y.
RTCC REQUIREMENTS FOR MISSION G: TRAJECTORY COMPUTERS FOR TLI AND MCC PROCESSORS, PART 1 Final Report
William E. Moore, Brody O. McCaffety (NASA. Manned Spacecraft Center, Houston, Tex.), and Bernard F. Morrey (NASA. Manned Spacecraft Center, Houston, Tex.) Apr. 1968 63 p refs
(Contract NAS9-4036)
(NASA-CR-92123; Rept.-68-4) CFSTI: $3.00 CSCL 09B

This note gives the trajectory computers of the translunar injection and midcourse correction processors. The term "Generalized Iterator" as used here refers to the whole program—supervisor, trajectory computer, and iterator. The iterator is a general formulation that applies to any problem involving the solution of a minimum or maximum value of a given function. This note gives the functional and detailed information about the trajectory computer, the subroutines used in constructing a trajectory, their function, and their algorithms. There are basically five types of trajectories generated by the TLI and MCC processors: (1) elliptical trajectories generated out of earth orbit (i.e., E-type ellipses and hybrid elipses); (2) x, y, z, and t return-to-nominal trajectories generated during translunar coast; (3) free-return trajectories generated from EPO or translunar coast; (4) free-return, BAP reoptimized trajectories generated during translunar coast; and (5) nonfree-return, BAP reoptimized trajectories generated during translunar coast. Author

N68-24310*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DUAL DETECTION SYSTEM FOR AIMP PFM DATA PROCESSING
Thomas J. Karras Washington May 1968 18 p
(NASA-TN-D-4561) CFSTI: $3.00 CSCL 09F

A dual detection system, used at present to process PFM telemetry data for satellites AIMP D and E at GSFC, has proved superior to a single threshold detection system. The dual system consists of: (1) threshold detection of 128 individual filters during buildup, when the filters are excited with a PFM burst, and (2) "auction detection," i.e., one filter (out of 128) which contains the largest amplitude near the end of the filter buildup. The threshold method is used only for system synchronization; the auction method is used only for data recovery. Auction and threshold detection use the same bank of filters. Up to 10 percent more data recovery on actual AIMP satellite tapes is being achieved; diminution up to one half in rms error in the experimenters analog data is expected. Test results on reprocessed telemetry data have shown a definite improvement in data recovery and resolution. The incoming signal-to-noise threshold of the system has not been lowered, because line synchronization has remained unchanged. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-23052 Auburn Univ., Ala.
THE DESIGN OF A HYBRID-TYPE S-BAND DIODE PHASE SHIFTER
Jerry William Rogers (Ph.D. Thesis) 1966 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-4682

A ring-hybrid microwave (S-band) phase shifter providing quantized phase shifts has been designed, analyzed, fabricated, and tested. This ring-hybrid design makes possible additional small phase shift increments without significant increase in loss. The phase shift element consists of a PIN diode, a transformer, and a length of open transmission line acting as a reactive element for tuning. The Smith Chart was used to design the desired phase increments, and criteria were developed for optimum circuit design of the elements. The strip-line design technique permits compensation for diode manufacturing variations. Cost is held to a minimum by use of relatively low-cost diodes. To verify these design criteria, a four-bit diode phase shifter for 1.8 GHz was constructed. The phase shifter, which consisted of a 180°, a 90°, a 45°, and a 22.5° phase bit, was constructed such that phase shifts of 360° in 22.5° increments are available. The insertion loss proved to be approximately 1.2 db with a nominal voltage standing-wave ratio of 1.25:1. Dissert. Abstr.

N68-23053# Army Electronics Labs., Fort Monmouth, N. J.
RADIATION CHARACTERISTICS OF APERTURE-LIMITED DOMINANT BEAM MODE OF LENS-TYPE BEAM WAVEGUIDE
F. Schwering Jan. 1968 35 p refs
(ECOM-2920; AD-666774)

The radiation characteristic of the dominant beam mode of a lens-type beam waveguide is discussed; the assumption is made that this mode illuminates a circular aperture in a metallic screen. Radiation patterns are presented for various aperture radii and various distances between the aperture plane and the last lens of the guide. The exact field distribution of the beam mode can be determined without extensive computations only at the location of the lenses, and this only for confocal guides. In all other cases, the Gaussian approximation of the mode function was used for calculation of the radiation characteristics. In the special case where the exact field distribution is known, the characteristics derived from this distribution have been compared with those obtained using the corresponding Gaussian approximation. For sufficiently large lens apertures the 3 dB beam width of the actual and the approximate patterns is nearly the same, while the side lobe level of the two patterns shows differences depending on the aperture radius. Author (TAB)

N68-23169# Eitel-McCullough, Inc., San Carlos, Calif.
DEVELOPMENT OF LINEAR POWER TUBES Interim Development Report, 17 Nov. 1967–16 Feb. 1968
Gordon E. Liljegren and William H. Sain 22 Mar. 1968 81 p
(Contract N00024-67-C-1044)
(TR-68-9; AD-666962)

An engineering model which meets the requirements of Phase II (intermodulation distortion of -45 db maximum third order and -50 db maximum fifth order with power output of 2000 to 5000 watts PEP) was delivered. A test report, which includes a proposed test specification prepared in MIL format, was also completed and submitted. The test report includes test results on two tubes of the same model. One tube was shipped and the other is available for further tests. For a given set of operating conditions, the intermodulation distortion ratio for both tubes is 50 db third and fifth order from zero to 5000 watts PEP output, with better than 50 per cent efficiency. Engineering models, using the EIMAC 4CX15000A as prototype, are being built and tested. These models are designed to meet the requirements of Phase III (5000 to 15000 watts PEP output with -40 db maximum third order intermodulation distortion). The first experimental models, which

were scaled from the successful Phase II design, were compared to the EIMAC 4CX15000A and were not as good in intermodulation distortion performance as the standard tube. The EIMAC 4CX15000A, when operated with zero signal plate current of 1.25 amperes, gives an intermodulation distortion ratio of 40 db third and fifth order in the power range from zero to 15 kW PEP. Additional experimental models are being designed and built in an attempt to reduce the required zero signal plate current and improve efficiency of operation. Author (TAB)

N68-23185# Radio Corp. of America, Somerville, N. J. Defense Microelectronics Activity.

HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS Quarterly Report, 1 Sep.–30 Nov. 1967

Morton L. Topfer, Joseph H. Mitchell, and Robert L. Schelhorn Mar. 1968 41 p

(Contract DA-28-043-AMC-01230(E))

(ECOM-01230-11; QR-11; AD-666776)

The TCR-vs.-ohms/sq. curve for hafnium thin-film resistors prepared on glass substrates is plotted and compared to that of samples prepared on glazed ceramic substrates. A technique for forming fine-line (0.5 mil) resistor patterns of hafnium has been developed. MOM capacitors and chip-size resistors using hafnium technology and related anodization processing were fabricated on passivated silicon wafers. Details of the work on hafnium-dioxide insulated MOS devices are presented. In addition, evaluation of the hafnium-dioxide films using C-V measurements is reported. A multivibrator circuit has been chosen as an experimental vehicle. The layout and masks for this circuit are presented. Author (TAB)

N68-23277# Army Electronics Labs., Fort Monmouth, N. J.

MULTISECTION WAVEGUIDE DIRECTIONAL FILTER

William P. Dattilo Dec. 1967 42 p refs

(ECOM-2910; AD-666759)

A five-section waveguide directional filter was fabricated and evaluated with regard to its practical use as a multiplexing filter. The use of multi-section filters is desirable in a practical multiplexing system due to the need for increased selectivity to isolate adjacent channels. In addition, a relatively broadband coupling technique has been investigated which permits the realization of bandwidths that are greater than a fraction of 1%, which up to now have been typical for these devices. A 1.3% bandwidth has been achieved using a two-slot iris geometry for the end couplings. The various problem areas associated with fabricating and testing the device are discussed and certain recommendations are made which should eliminate their causes and result in a further improved filter. Author (TAB)

N68-23341# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

COMPLEMENTARY INSULATED GATE FIELD EFFECT TRANSISTOR CIRCUITS

Jon Christian Zimmerman (M.S. Thesis) Nov. 1967 111 p refs

(GE/EE/67S-9; AD-666645)

New circuits of higher order complementarity were investigated. Ten of these circuits exhibited unusual static volt-ampere characteristics. At least two applications were found for each circuit. Ten linear and digital applications were found for one circuit; it also exhibited an extensive negative resistance region. A discussion of various types (orders) of complementarity is presented and a list of properties for determining the order of complementarity is proposed. The study demonstrated the existence of a correlation between complementarity and versatility. However, additional research is needed to explore further the exact nature of this correlation. Author (TAB)

N68-23460*# Franklin Inst., Philadelphia, Pa. Research Labs.

RF EVALUATIONS OF THE STRAY ELECTRICAL ENERGY INDICATOR (SEEI) Final Report

P. F. Mohrbach and R. R. Raksnis Jan. 1968 33 p

(Contract NAS9-7601)

(NASA-CR-92106; F-C2142) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The RF sensitivity of 80 SEEI initiators was determined at 6 test frequencies including both CW and pulsed power and in two terminating modes. The data were compared with the single bridgewire Apollo standard initiator (SBASI) tests and results of both types are presented. Analysis of the data indicated that that the SEEI is more sensitive than the SBASI at all comparable test frequencies and modes. The largest spread in sensitivities occurs in the pin-to-pin mode at the low and moderate CW frequencies. With pulsed power the difference in the sensitivities of the two is reduced to about 2 to 1 for the pin-to-pin mode and 4 to 1 for pin-to-case. Both the SBASI and the SEEI are sensitive to pulsed power with the 50% fire levels falling approximately in the 0.02 to 0.2 watt decade for all pulsed tests and modes. The most sensitive condition occurred at 9000 MHz pulsed with the SEEI terminated for a pins-to-case excitation. At this condition a fire was produced with 0.015 watts. Input impedance measurements conducted in the frequency band of 1.5 to 1300 MHz with CW generators showed a marked difference in pin-to-pin values of impedance. Pins-to-case values showed no great difference between the two types. Author

N68-23546# Technische Hogeschool, Eindhoven (Netherlands).

DIODES AND TRANSISTORS UNDER HIGH LOCALIZED PRESSURE

Kornelis Bulthuis (Ph.D. Thesis) 5 Apr. 1968 94 p refs

Stress effects on the characteristics of germanium and silicon p–n junctions are discussed in terms of the various parameters which influence the current changes. Measurements on the stress sensitivity of the collector and base current of silicon transistors are described, and it is shown that the experimental results obtained for forward currents can be explained quantitatively in terms of a change in energy gap. Experiments were conducted to assess the effect of local pressure on the forward and reverse currents of germanium p–n junctions, and on the stored charge and forward currents of germanium p–n and p–s–n structures. The data obtained are also interpreted in terms of the changes in energy gap. Measurements were made on germanium and silicon diodes stressed in the three main crystallographic directions, and the values of the pressure dependence of the energy gap are compared with the values obtained from the deformation-potential theory. The validity of the simplified pressure pattern, assumed in the semiconductor when stressed by a spherical point, is considered. M.G.J.

N68-23566# General Electric Co., Schenectady, N. Y. Research and Development Center.

THE LUCALOX LAMP

J. E. Burke Aug. 1967 6 p Presented at a Seminar in the Met. Dept. at MIT, Cambridge, Mass., Dec. 1966

(Rept.-67-C-287)

A brief history is given on the development of the Lucalox lamp, a sodium vapor lamp of exceedingly high luminous efficiency which produces substantially white light. The work which led directly to the high density aluminum oxide is described, and procedures for making it reproducibly of acceptable quality are discussed. The problems encountered in the construction of the lamp are also delineated. B.S.D.

N68-23594# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Electrophysics Dept.
WIDE-ANGLE INTERNAL DEFLECTION STRUCTURES OF CATHODE-RAY TUBES Triannual Report, 1 Jul.–31 Oct. 1967
Rudolf G. E. Hutter Feb. 1968 16 p
(Contract DA-28-043-AMC-02449(E))
(PIBMRI-1355.4-67; Rept.-4; ECOM-02449-4; AD-666794)

Factors that determine spot size in cathode-ray tubes are examined. The suitability of a modified Pierce gun for use in cathode-ray tubes is being investigated. A method for measuring spot size and current distribution in the spot is analyzed. Electron guns for use in a multigun cathode-ray tube were designed. Author (TAB)

N68-23677 Oregon State Univ., Corvallis.
THIN-FILM WIDEBAND TUNNEL-DIODE AMPLIFIER
Edmund Jui-Ching Hsieh (Ph.D. Thesis) 1966 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-715

Wideband tunnel-diode amplifiers using common-base transistor stages for isolation were investigated for stability criteria, frequency response, and the effects of temperature and voltage supply fluctuations. For the first time the full frequency spectrum of a tunnel-diode, from d-c to the gigahertz (GHz) range, was able to be utilized in an amplifier. Three experimental circuits constructed by conventional as well as thin-film techniques were tested. They represented a workable model of a new design of a tunnel-diode amplifier capable of having constant gain over a frequency spectrum from d-c to one-half GHz. It was shown that this design principle could be applied to extend the upper frequency limit to a few GHz if higher frequency tunnel-diodes and better circuit construction techniques are employed. Dissert. Abstr.

N68-23778 Minnesota Univ., Minneapolis.
NOISE IN UHF AND MICROWAVE TRANSISTORS
Dimitrios Constantinos Agouridis (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-1

A study of the noise of the U.H.F. and microwave transistors is presented, in the frequency range between 4 MHz and 1000 MHz, as a function of emitter current and collector voltage. These transistors are type p^+–n–p^- and show saturation effects in the collector p^--region at high emitter currents. At low emitter currents the noise figure is high, mostly due to the shunting effect of the emitter junction capacitance. At the intermediate currents the noise figure varies with frequency as predicted by van der Ziel's equation. At high currents the noise figure rises rapidly as predicted by the f_α-fall off with current, because of the saturation effects. The variation of the noise figure with collector voltage may be predicted by the variations of the transistor parameter with V_{BC} (base width modulation), and the saturation effects. Dissert. Abstr.

N68-23796 Ballistic Research Labs., Aberdeen Proving Ground, Md.
CORRELATED X-RAY AND OPTICAL STREAK PHOTOGRAPHS OF EXPLODING WIRES
Kevin S. Fansler and Donald D. Shear Dec. 1967 22 p refs
(BRL-R-1385; AD-667363)

Sequences of flash x-ray photographs obtained during the early expansion of copper, lead, and iron wires are correlated precisely in time with the electrical voltage pulse and optical streak photographs. Wire sizes were 10, 15, and 25 mils diameter. The x-ray pictures show the onset and development of striations in each of these metals along the wire length during the fast resistance rise of the wire. The relatively smooth envelope of the radially expanding striations is compared with features of the optical streak pictures. Some of these optical pictures show a translucent radial cloud developing prior to the fast resistance rise, and a more opaque inner core which expands radially. Most of the striations in the x-ray pictures appear to be completely separated at the voltage maximum. After the voltage peak the density of material appears to be less nearer the center. The observed behavior is discussed. Author (TAB)

N68-23846# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
NUCLEAR RADIATION EFFECTS ON ELECTRONIC COMPONENTS AND APPARATUS. A SELECTIVE BIBLIOGRAPHY, OCTOBER 1964–JULY 1967
H. Amelink, comp. Dec. 1967 78 p refs
(TDCK-49707) CFSTI: HC $3.00/MF $0.65

A bibliography is presented on the radiation effects on electronic apparatus, materials and devices, including also subjects like nuclear explosion effects on radio communication, radar and ionosphere. Author

N68-23856# Missouri School of Mines and Metallurgy, Rolla.
NUCLEAR RADIATION EFFECTS ON SILICON P–N JUNCTIONS
Charles A. Goben 1968 45 p Feb. 1968 45 p refs
(Contract AT(11-1)-1624)
(COO-1624-11) CFSTI: HC $3.00/MF $0.65

Equipment was purchased (or fabricated) and integrated to form the sophisticated electronic measuring apparatus required for studying nuclear radiation effects in silicon p–n junctions. Work is in progress to examine the anomalous annealing phenomena reported by the principal investigator for the neutron-induced defects in the neutral and space-charge regions of p–n junction devices through isothermal and isochronal annealing techniques. A study is being made of the radiation and annealing behavior of devices operated in the inverse configuration so that a relatively wide depletion region is available for determination of the damage constant for the neutron-induced current component originating in the depletion layer. It has been determined that the neutron-induced defects are field dependent and a study is under way to determine more about the fundamental properties of these defects. Work is in progress to construct and fit a statistical recombination model to the observed neutron-induced base current component in silicon transistors. Author (NSA)

N68-23911# General Electric Co., Owensboro, Ky. Tube Dept.
THREE HUNDRED MILLIWATT X-BAND TRIODE OSCILLATOR Quarterly Report, 1 Oct.–31 Dec. 1967
J. M. Connelly and L. F. Jeffrey Mar. 1968 35 p
(Contract DA-28-043-AMC-01795(E))
(QR-8; ECOM-01795-8; AD-667424)

Eighty Y-1613 triodes were made representing several different type cathode structures. Fourteen tubes having nickel base cathodes, and three featuring dispensar cathodes and bonded heaters, were made available for rf testing. A triode having a nickel base cathode gave best operation life (265 hours) of tubes tested to date. Author (TAB)

N68-23979# General Electric Co., Syracuse, N. Y. Electronics Labs.
THE THEORETICAL NONLINEAR DISTORTION IN VARACTOR PARAMETRIC AMPLIFIERS
C. E. Nelson May 1967 73 p refs
(R67ELS-37)

The analysis of Penfield and Rafuse is extended to determine the third-order intermodulation products and the nonlinear gain and

phase characteristics (at low distortion levels) of varactor parametric amplifiers for varactor nonlinear exponents other than 1/2 (abrupt-junction). The analysis includes reciprocal general coupling networks and a general continuous nonlinear capacitance function, as well as the ideal varactor nonlinearity with exponent n. A series of curves are presented for the third-order relative power intermodulation proudct and the nonlinear gain and phase distortion for a simplified, resonant, equivalent circuit and for n = 1/2, 0.4 and 1/3. Optimum pump-frequency to signal-frequency ratios are presented to minimize the nonlinear distortions for the simplified circuit. Author

N68-24017# Atomic Energy Commission Research Establishment, Riso (Denmark).
ANALYSIS OF FAILURE DATA FOR ELECTRONIC EQUIPMENT AT RISO FOR THE PERIOD 1960–1965
P. Timmermann Oct. 1967 14 p
(RISO-165)

An analysis is made of failures in electronic equipment for the five-year period 1960–1965. The data are presented from the point of view of reliability prediction and not as a feedback for a more reliable design. Author (NSA)

N68-24056 Bunker-Ramo Corp., Canoga Park, Calif. Defense Systems Div.
PLANAR COAXIAL INTERCONNECTION TECHNIQUES Semiannual Report, 1 Apr.–30 Sep. 1967
Howard L. Parks, William Griff, and Tom Kitaguchi Mar. 1968 116 p
(Contract DA-28-043-AMC-02024(E))
(F058-7U13; ECOM-02024-5; SAR-1; AD-667368)

The semi-annual technical report documents the research and developmental effort for Phase I of the follow-on program concerning a Multilayer Planar Coaxial Interconnection System. The primary objectives of the program are to optimize developments of materials and fabrication techniques for a multilayer planar coaxial structure which is applicable for interconnecting subassemblies and assemblies utilized in computers operating in the 20- to 50-MHz range. The developmental areas essential to providing such a multilayer system are documented in this report. These include investigations of improved etching techniques, dielectric systems, conductor applications, lamination methods, through-hole plating technology, and microbonding. The experimental developmental model designed for the Phase I effort is a pseudorandom code generator, which is comprised of a 5-stage shift register with two exclusive OR circuits and a propagation delay oscillator for clock. Operation of this pseudorandom clock generator was at 70 MHz, which showed a capability higher than the program goals of 20 to 50 MHz. Manufacturing specifications for the multilayer structure have been established and documented in this report with regard to material requirements, sources of supply, fabrication processes, and design guides (including details of equipment, special tooling, and parts). Author (TAB)

N68-24205# Radio Corp. of America, Camden, N. J.
MODELING OF INTEGRATED CIRCUIT EFFECTIVENESS (MICE) Final Technical Report
Bernard F. Tiger and David I. Troxel Griffiss AFB, N. Y. RADC Jul. 1967 111 p refs
(Contract AF 30(602)-3526)
(RADC-TR-67-267; AD-658199)

A Stress Survival Matrix Test (SSMT) and Physical Effects Analysis (PEA) program was conducted on a type of monolithic silicon integrated circuit from two vendors. The purposes of the program were to identify the basic reliability characteristics of integrated circuits and determine an approach of reliability prediction having greater practicality and validity than the currently used techniques. The development of the SSMT analysis of the resulting data, and the PEA results are described. It is shown that the reliability of suitably used integrated circuits is not primarily a function of usage factors such as temperature, power or shock. It is more directly dependent on (1) screening effectiveness, (2) the failure mechanisms which exist in field use units and (3) the life distributions and environmental susceptibilities of the units which have these failure mechanisms. These results suggest that failure rate decreases with time as the deviate units (i.e., those containing failure mechanisms) drop out of the population of survivors. The problem of assuring suitable usage is discussed. Finally an appropriate prediction approach, incorporating the pertinent factors that affect reliability, is identified. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-23067# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROLS LEADING TO OPTIMAL STATIONARY REGIMES [OB UPRAVLENIYAKH, PRIVODYASHCHIKH K OPTIMATL'NYM STATSIONARNYM REZHIMAM]
O. V. Viskov and A. N. Shiryayev 19 Sep. 1967 20 p refs Transl. into ENGLISH from Tr. Mat. Inst. (USSR), v. 71, 1964 p 35–45
(FTD-HT-67-69; AD-666741)

The authors define a controlled Markov chain as one for which the passage probabilities are defined by P(xi sub (n + 1) = X sub (n + 1) (vertical line) xi sub n, d sub n); n = 0,1,... where d sub n is an element which may be chosen from a space D as a function of x sub 0,...,x sub n. A choice of d sub n(x sub 0,...,x sub n) for each n = or > 0 is called a control delta; and it is noted that the process (xi, delta), xi = (xi sub 1, xi sub 2,...), delta = (d sub 1, d sub 2,...) is generally not really Markovian (since the further past has too much influence). The control delta is called Markovian if each of the functions d sub n depends only on x sub n, and homogeneous Markovian if in addition, all d sub n are the same. The authors define admissible controls; they define optimal controls in terms of a loss function W(x, d) where x is the state of the system and d the chosen control. They answer the question of existence of optimal controls and optimal homogeneous Markov controls for the very special case of finite state and control spaces. TAB

N68-23071 California Univ., Los Angeles.
THE APPLICATION OF THE METHOD OF QUASILINEARIZATION TO THE COMPUTATION OF OPTIMAL CONTROL
Garrett Paine (Ph.D. Thesis) 1966 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4479

This dissertation is concerned with the theoretical and practical techniques for handling the control directly, and for widening the range of convergence of the method of quasilinearization. Proofs are presented showing the quadratic convergence of a modified method for handling control directly and extension of the range of convergence by another modification to the method. The modified methods were tested on two problems: the classical Brachistochrone, and the problem of determining the control for a reentering space craft for minimum convective heating: the latter problem is a difficult test for any technique since it has no "nice" properties: it is both computationally complex and sensitive to

small errors. The methods developed for extending the range of convergence of quasilinearization and for handling bounded control directly were shown to be easily applied and of value in obtaining a solution to the reentry problem, proving their worth in solving practical engineering problems. Dissert. Abstr.

N68-23078# Stanford Research Inst., Menlo Park, Calif.
DECOMPOSITION THEORY OF SEMIAUTOMATA AND AUTOMATA Final Report, Jul.–Dec. 1967
Michael Yoeli and James Turner 8 Dec. 1967 61 p refs
(Contract F19628-67-C-0295)
(AFCRL-67-0686; AD-666689)

The report is divided in three parts. Part A establishes a general algebraic theory of semi-automata and automata decompositions. Homomorphic relations and their applications to transition graphs are considered. These relations extend the concept of homomorphic functions, and suitably generalize well known results on partitions having the substitution property and quotient algebras. Both completely and incompletely specified transition graphs are considered. The relationship between automata behavior and the algebraic structure of their semi-automata is considered. The final section of Part A relates cascade decompositions of automata involving two or more components to the algebraic structure of their semi-automata. Part B discusses various aspects of cascade-decomposition techniques for Mealy automata. An attempt is made to combine the engineering viewpoint of the decomposition theory of Hartmanis and Stearns with the mathematically elegant but uneconomical decomposition theory of Krohn and Rhodes. New results are obtained on the proper selection of a tail machine. Efficient techniques for the cascade decomposition of some classes of semi-automata are discussed. Further research in this direction appears very promising. Part C discusses state splitting for single input machines. A concept of a useful split is introduced. Criteria for a transformation graph to have a useful split or to have only useless splits are developed. Author (TAB)

N68-23084# Northwestern Univ., Evanston, Ill. Technological Inst.
ON OPTIMAL SOLUTIONS OF 2-PERSON 0-SUM GAMES
Adi Ben-Israel Mar. 1968 8 p refs *Its* System Res. Mem. No. 195
(Contracts Nonr-1228(10); DA-31-124-ARO(D)-322; Grant NSF GP-7550)
(AD-666814)

Optimal solutions of 2-person 0-sum games are characterized in terms of certain submatrices of the payoff matrix. Author (TAB)

N68-23141# General Electric Co., Schenectady, N. Y. Research and Development Center.
OPTIMAL CONTROL FOR THE ENGINEER. 2: DYNAMIC OPTIMIZATION PROGRAM (DYNOP)
C. H. Schley, Jr. Apr. 1967 89 p refs
(Rept.-67-C-130)

Consideration is given to the structure and use of a Dynamic Optimization Program (DYNOP), a general program for the solution of problems in optimal control. Both trajectory synthesis and controller synthesis can be performed by this program, which is an implementation of an optimization technique based on the second variation. Trajectory synthesis is performed by means of a feedback control algorithm. Essentially, the program may be used to design a system with linear feedback control. Author

N68-23151# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERAL RESEARCH Quarterly Technical Summary Report, 1 Nov. 1967–31 Jan. 1968
Frederick C. Frick, Alexander V. Nedzel, Stephen H. Dodd, Malvin A. Herlin, Jerome Freedman et al 15 Feb. 1968 53 p refs
(Contract AF 19(628)-5167)
(ESD-TR-68-10; AD-666712)

The summary covers the period from 1 November 1967 through 31 January 1968. It consolidates the reports of Data Systems, Radio Physics, Radar, Engineering, and Solid State physics on the General Research Program at Lincoln Laboratory. TAB

N68-23172# Radio Corp. of America, Princeton, N. J. RCA Labs.
FUNDAMENTALS OF THRESHOLD LOGIC
Robert O. Winder Jan. 1968 122 p refs
(Contract F19628-68-C-0070)
(AFCRL-68-0066; SR-1; AD-666650)

These notes on threshold logic are intended as intermediary material between a completely geometric, heuristic presentation and the more formal source material available in the literature. Basic definitions and simple properties of threshold function are developed, followed by a complete treatment of monotonicity theory - algorithms for positivization and ordering of arguments are given, both geometric and algebraic. Heuristic, Chow-parameter, and linear-program methods of test-synthesis are presented, along with discussions of reduction theory and partially specified functions. A geometric synthesis method for networks of 3-input majority gates is given, and the authors method of general network synthesis discussed geometrically. Two basic tables are included. Although only the more basic concepts have been treated, a complete bibliography is provided, together with suggestions for further reading. Author (TAB)

N68-23196# System Development Corp., Santa Monica, Calif.
ON THE ELIMINATION OF ENDMARKERS
Seymour Ginsburg and Michael A. Harrison 24 Oct. 1967 23 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(TM-738/040/00; SR-13; AFCRL-67-0666; AD-666922)

It is proven that one endmarker can be eliminated from a stack acceptor without affecting recognition power. It is also noted that both endmarkers can be eliminated from deterministic linear bounded acceptors. Author (TAB)

N68-23240 Texas Univ., Austin. Labs. for Electronics and Related Science Research.
A STUDY OF THE MODAL PROPERTIES OF LINEAR DYNAMICAL SYSTEMS
Harold D. Albertson and B. F. Womack 31 Jan. 1968 108 p refs
(Grant AF AFOSR-766-67)
(TR-44; AFOSR-68-0290; AD-666899)

A study of various modal properties of linear, dynamical systems is carried out in this investigation. The problem of constructing minimum-state realizations of transfer function matrices is considered in detail. A solution to the problem of determining the minimum number of outputs required to observe all the dynamic modes of a system and the minimum number of inputs required to excite all system modes is presented. Algorithms for removing uncontrollable and unobservable state variables from time-variable as well as constant parameter systems are developed. TAB

N68-23250 North Carolina State Coll., Raleigh.
A GENERALIZED MODEL FOR THE OPTIMAL SELECTION OF QUALITY CONTROL TEST PARAMETERS
Herbert Allan Knappenberger (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-5682

A general expected cost model of a process controlled by a statistical quality control procedure is developed. The state of the process is assumed to be characterized by the value of a single process parameter. The *a priori* distribution of this process parameter is assumed to be known. It is further assumed that the *a priori* distribution can be satisfactorily approximated by a finite discrete distribution. Using this approximate distribution and treating the movement of the process parameter as a finite state Markov chain, the transition probability matrix is developed. A general method for calculating the steady state probabilities of the process being in each of the given states is presented. From these steady state probabilities the expected cost is calculated. A two stage numerical procedure is developed and programmed for a digital computer to determine the sample size (N), the interval between samples (K) and the critical region parameter (L) which minimizes the expected cost. Dissert. Abstr.

N68-23381 Texas Univ., Austin.
ANALYSIS AND DESIGN OF OPTIMAL CONTROL SYSTEMS FOR DYNAMICAL PROCESSES WITH TIME DELAYS
Henry Robert Sebesta (Ph.D. Thesis) 1966 195 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-3349

Theoretical concepts are developed for the analysis of optimal control problems in dynamic systems that involve time delay phenomena. Necessary conditions of optimality are given for problems containing multiple, non-constant time delays in both the state and control variables of a physical system. These results are obtained by the application of some modifications of variational calculus. For the nonlinear problems and for those linear systems which cannot be handled with the analytical procedures, there is proposed a method whereby a computational solution can be obtained. The basis for the development of this algorithm is the gradient (or steepest ascent) technique widely used for conventional nonlinear control problems. For certain classes of linear systems it is possible to guarentee that the numerical solution obtained with this algorithm will converge to the optimal results. The theoretical concepts are illustrated with several realistic examples, including the guidance problem for a vehicle in interplanetary flight. Dissert. Abstr.

N68-23403 Johns Hopkins Univ., Baltimore, Md.
ADAPTIVE SUB-OPTIMAL CONTROL BASED ON MINIMAX-DEVIATION
Robert Joseph Walinchus (Ph.D. Thesis) 1966 140 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-3010

The purpose of this work is to generate a constrained control philosophy—an algorithm or suboptimal policy—based on a knowledge of unconstrained solutions of a certain functional form which are easily manipulated. Considered is a class of finite-time, constrained-control systems, with or without noise, which must move the state of the system from some element of a set of initial conditions to any element of a set of terminal conditions. The object of the investigation is to find an optimal (or sub-optimal) control which satisfies the constraints and minimizes (or approximately minimizes) a primary performance criterion. Two essentially new primary criteria for effective adaptive control are given, and both are shown to yield realistic policies for converting a specific unconstrained solution into a solution of the constrained-control problem. The specific unconstrained solution is not arbitrary, but unique and obtained with the aid of minimax-deviation and weighted-energy criteria. Dissert. Abstr.

N68-23414*# Connecticut Univ., Storrs. School of Engineering.
CONTROL OF LINEAR UNSTABLE SYSTEMS VIA THE DIRECT METHOD OF LIAPUNOV
J. D. Gay, D. P. Lindorff, and T. M. Taylor Nov. 1967 64 p refs
(Grant NsG-309)
(NASA-CR-94578) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The control of an unstable linear system whose output is directly related to the lowest order phase variable of the system is investigated. A bounded disturbance vector is included in the system equations. A transformation to the required canonic form is defined using a semi-definite Liapunov function. The region in the state space in which the controller can insure stability is examined. The validity of the control law within a region is found to be unsufficient to insure stability in that region. The control law is made valid by defining another region and system motion that is constrained to lie within the region. The problem of selecting an appropriate switching line is examined. The synthesis technique is applied to a complex sixth order system consisting of a two segment inverted pendulum hinged in the center by a spring representing elastic stiffness and mounted on a frictionless car. A horizontal force controls the cart. Cart position changes are commanded by a reference input to the model. The results of system simulation studies are included. R.N.A.

N68-23438*# Stanford Research Inst., Menlo Park, Calif.
DESIGN OF GUIDANCE AND CONTROL SYSTEMS FOR OPTIMUM UTILIZATION OF INFORMATION
L. Meier, J. Peschon, B. Ho, R. Larson, and R. Dressler Washington NASA May 1968 129 p refs
(Contract NAS2-3476; SRI Proj. 5967)
(NASA-CR-997) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A comprehensive scheme is described for designing control systems in the presence of uncertainties about initial plant state and plant parameters, disturbance inputs, and measurement noises. The method is based upon treating these random effects as perturbations on a nominal trajectory corresponding to plant operation without the random effects and with a nominal control as input. As a first approximation, the deterministic optimum is used for the nominal control, with optimal linearized estimation and control of the plant about the nominal trajectory. Next, the sensitivity of system performance to the random effects is computed; if this sensitivity is too great, then improved performance may be obtained by use of adaptive control and modification of the nominal control. If adaptive control is not used, reduced sensitivity can also be obtained by modifying the linear estimation and control in addition to the nominal control. Performance computations are accurate to terms of second degree in the perturbations. Optimization of the measurement system from two points of view is considered. Author

N68-23485 Columbia Univ., New York.
ANALYSIS AND SYNTHESIS OF MULTIPORT ACTIVE NETWORKS
Carl Dennis Weiss (Ph.D. Thesis) 1966 325 p
Available from Univ. Microfilms: HC $14.65/MF $4.20 Order No. 67-814

This thesis is concerned with the characterization, analysis, and synthesis in the complex frequency domain of transformerless multiport networks composed of resistors, capacitors, inductors, and negative resistors (±RLC's). Having established the most general behavior of RLC networks with n or more negative resistors, the second half is concerned with determining the behavior of resistive n-ports with k negative resistors, $1 < k < n$. It is shown that any such n-port with any port-structure is equivalent to a special, simple, canonical network with k or fewer negative resistors. Finally, some special resistive networks are examined in detail, including 2-ports realizable with one negative resistor; and 3- and 4-terminal ideal transformer equivalent circuits which contain positive and the minimum number of negative resistors. Dissert. Abstr.

N68-23487 California Univ., Los Angeles.
A NONLINEAR PERTURBATION THEORY FOR ESTIMATION AND CONTROL OF TIME DISCRETE STOCHASTIC SYSTEMS
Harold Wayne Sorenson (Ph.D. Thesis) 1966 241 p
Available from Univ. Microfilms: HC $11.05/MF $3.15 Order No. 67-453

The problem of determining optimal estimation and control policies from noisy measurement data for time-discrete, stochastic, dynamical systems is considered. The method that is proposed for the solution of these problems represents a generalization of the common approach that is based on the application of linear theory. In applying linear theory, it is assumed that the state and measurement perturbations of the actual system relative to an arbitrary system can be described by linear equations. Then, it is possible to apply well-known linear techniques to estimate the state perturbations and to determine the desired control corrections. In this invesgiation, terms of higher order than first are retained in describing the perturbations. The determination of estimation and control policies for the resulting nonlinear systems is then accomplished within the framework of the so-called Bayesian approach. Dissert. Abstr.

N68-23493 Florida Univ., Gainesville.
RAPID IDENTIFICATION OF TIME-VARYING LINEAR DYNAMIC SYSTEMS
William Clay Choate (Ph.D. Thesis) 1966 153 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-358

A scheme for the identification of time-varying linear dynamic systems is presented. The scheme is formulated in terms of a time-varying vector-valued frequency transform. It is shown that the vector transform completely characterizes the response of the system, and that it is simply related to the matrices which define the system. Using this relationship, these matrices can be determined if the vector transform can be evaluated. A method is presented for estimating the transform from measurements made of the response of the system. And the factors which place a fundamental limit on the accuracy of the estimates are studied.
Dissert. Abstr.

N68-23521 Columbia Univ., New York.
REPRESENTATION AND REALIZATION OF TIME VARIABLE LINEAR SYSTEMS
Leonard Michael Silverman (Ph.D. Thesis) 1966 191 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-840

This research is concerned with a study of time-variable linear systems with particular emphasis on those system properties and concepts that can be characterized without solving time-variable differential equations. Criteria are developed for determining the degree of controllability and observability of a time-variable system. These criteria are based on the rank of the controllability and observability matrices, newly defined quantities formed from the system coefficient matrices and a finite number of their derivatives. Based on the theory of equivalent systems and the criteria for controllability and observability, a new approach to the synthesis of nonstationary impulse response matrices is developed. This method of synthesis, which does not require an a priori assumption of separability, provides a systematic procedure for realizing a wide class of impulse responses. Dissert. Abstr.

N68-23553*# Tyco Labs., Inc., Claremont, Calif. General Nucleonics Div.
NUCLEONIC LUNAR RANGING AND TRACKING SYSTEM
Final Report
[1967] 70 p
(Contract NAS8-20562)
(NASA-CR-61763; FR-416) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Low energy gamma ray, pulsed isotope, and pulsed X-ray tube approaches to the design and development of a nucleonic lunar ranging and tracking system for lunar landing vehicles are discussed. It is demonstrated that of the three, the pulsed X-ray approach is the most feasible. This technique involves the emission of short bursts of X-rays which travel to the lunar surface and are reflected back to an onboard detector subsystem. Data processing electronics then determine the altitude by converting the elapsed time to a representative analog signal and displaying the results on an indicator or meter. The design and fabrication of a breadboard model of the X-ray source subsystem and the data processing electronics are described. The techniques and apparatus used in the simulation of a lunar landing are discussed and test results are included. It is shown that the X-ray signal reflected from the ground has more than sufficient strength to operate the data processing electronics, and is capable of altitude measurements to 500 feet. Specific modifications and improvements are recommended as are additional uses for the X-ray system in tactical low level altimeter and air density measurement applications. E.J.S.

N68-23561* Denver Univ., Colo.
EXTENSION OF MODERN CONTROL SYSTEM THEORY
Final Report
Henry D'Angelo and Maynard L. Moe Mar. 1968 50 p refs
(Grant NsG-518; DRI Proj. 3638)
(NASA-CR-93731) CFSTI: $3.00 CSCL 09C

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2. A COMPUTER-AIDED DESIGN TECHNIQUE FOR SAMPLED-DATA CONTROL SYSTEMS F. D. Hauser (Martin Co.) and M. L. Moe 4 p refs (See N68-23563 13-10)
3. AN OPTICAL FIXED CONTROL STRUCTURE DESIGN WITH MINIMAL SENSITIVITY FOR A LARGE ELASTIC BOOSTER T. C. Hendricks (Martin Co.) and H. D'Angelo 11 p refs (See N68-23564 13-10)
4. OPTIMAL CONTROL OF PLANTS WITH RANDOM SLOWLY-VARYING PARAMETERS L. B. Patrick and H. D'Angelo 10 p refs (See N68-23565 13-10)

N68-23562* Denver Univ., Colo.
TRAJECTORY SENSITIVITY OF AN OPTIMAL CONTROL SYSTEM
Henry D'Angelo, Maynard L. Moe, and Thomas C. Hendricks *In its* Extension of Mod. Control System Theory Mar. 1968 11 p
(See N68-23561 13-10)
(Grant NSF- GK-274)

A method is introduced for analytically determining the optimal control for a linear system with respect to a performance functional that includes trajectory sensitivity. Specifically, the control law is found for the system described by a state-variable differential equation. Numerical determination of the optimal-control law is achieved by the solution of a nonlinear algebraic matrix equation. Implementation of the optimal control requires generation of trajectory sensitivity vector which is done in a straight-forward manner: for an n-th order system, the trajectory sensitivity vector requires n integrators for its simulation. Author

N68-23563* Denver Univ., Colo
A COMPUTER-AIDED DESIGN TECHNIQUE FOR SAMPLED-DATA CONTROL SYSTEMS

F. D. Hauser and Maynard L. Moe (Martin Co., Denver, Colo.) *In its* Extension of Mod. Control System Theory Mar. 1968 4 p refs (See N68-23561 13-10)

A technique is presented for compensator design which includes constraints on peak time, overshoot, settling time, peak value of the controller output, and velocity error constant. A basic feature of the design technique is the formation of a figure-of-merit, which is a linear combination of the design objectives, and a minimization by adjustment and addition of compensator gain, poles, and zeros under the control of a multilevel decision procedure. Examples are given showing favorable comparisons to several other synthesis techniques. Author

N68-23564* Denver Univ., Colo.
AN OPTICAL FIXED CONTROL STRUCTURE DESIGN WITH MINIMAL SENSITIVITY FOR A LARGE ELASTIC BOOSTER
Thomas C. Hendricks (Martin Co., Denver, Colo.) and Henry D'Angelo *In its* Extension of Mod. Control System Theory Mar. 1968 11 p refs (See N68-23561 13-10)

A design algorithm developed for the minimization of a cost functional which includes, in addition to state and control variables, a measure of sensitivity, is used to solve an example of practical interest: a flexible ballistic missile in powered flight. Comparisons are made between optimal designs which include sensitivity in the performance index and those that do not. The efficacy of using a measure of sensitivity in the performance index is demonstrated. Author

N68-23585* Denver Univ., Colo. Dept. of Electrical Engineering.
OPTIMAL CONTROL OF PLANTS WITH RANDOM SLOWLY-VARYING PARAMETERS
L. Benjamin Patrick and Henry D'Angelo *In its* Extension of Mod. Control System Theory Mar. 1968 10 p refs (See N68-23561 13-10)
(Grants NsG(T)-49; NSF GK-274)

A method is given for obtaining the optimal control law for plants containing a random slowly varying parameter whose probability density function is known. The necessary conditions for the optimal control law are derived using the calculus of variations, and a method is advanced for approximating the optimal control law in closed loop fashion. A numerical illustrative example is worked and the results are compared with both an optimal system designed about the nominal value of the parameter, and an adaptive system whose control law changes to the optimal for the existing parameter value. Author

N68-23579 Oregon State Univ., Corvallis.
CIRCUIT CHARACTERIZATION FOR EFFICIENT COMPUTER ANALYSIS
Waldo George Magnuson, Jr. (Ph.D. Thesis) 1966 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-728

This investigation develops guidelines for efficiently modeling active devices and circuits for time domain analysis using general network analysis computer programs. The amount of computer time required for large-signal transient analyses is investigated both analytically and experimentally in terms of the network parameters. Three factors are found to be important in determining the amount of computer time that will be required in performing a computer analysis of a network. The factors are: (1) the number of nodes the network contains; (2) the network time constants and network natural frequencies; and (3) the representation of the circuit elements comprising the network. The application of guidelines based on these factors is directed primarily to large-signal transistor circuits but their application to the field of integrated circuits is also indicated. Dissert. Abstr.

N68-23599*# Rensselaer Polytechnic Inst., Troy, N. Y.
LEARNING MODELS FOR ADAPTIVE SYSTEM IDENTIFICATION, PART A Final Report
James W. Sherman Oct. 1967 115 p refs
(Grant NGR-33-018-014)
(NASA-CR-94583) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Operational problems of identification, adaptation, and sensitivity in optimal control systems were studied by developing a general method of system identification for execution on a digital computer as pattern recognition device. The systems output is represented as a functional which is approximated by transformation from the operating history of the system to the output of the system. Viewing this transformation as a hypersurface in an N-dimensional space leads to the use of pattern recognition techniques for identification. Training procedures include models based on delay line and difference equation representation for any physical system. These models can be linear or nonlinear and include inverse terms; they allow a trade-off between computational complexity, speed of identification, and control of identification error due to measurement noise. G.G.

N68-23608 Texas A&M Univ., College Station.
INVESTIGATION OF A VIBRATING MOMENTUM EXCHANGE DEVICE
Donald Franklin Sellers (Ph.D. Thesis) 1966 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-256

This report describes the results of a research program to investigate a new type of satellite attitude controller. It is a momentum exchange device and will be referred to as the VMED (Vibrating Momentum Exchange Device). An analytical study was conducted to determine its expected operating characteristics. A single axis unit comprised of the VMED and the associated electronics was designed and constructed. An experimental program involving a closed loop simulation was conducted to verify the concept. The results were generally favorable and demonstrated that the VMED was able to change the angular position of an air bearing table in a controlled manner. Dissert. Abstr.

N68-23678# Systems Technology, Inc., Hawthorne, Calif.
OPTIMIZATION ON LINEAR AND NONLINEAR SYSTEMS BY MINIMIZATION OF AUXILIARY EFFORT Final Report
Julian Wolkovitch Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Feb. 1968 212 p refs
(Contract F33615-68-C-1169)
(STI-TR-900-1; AFFDL-TR-67-193; AD-667554)

The optimization of control systems by an original method called minimization of auxiliary effort (M.A.E.) is discussed. This method yields an approximation to the true optimum, which is defined as that system having a response which in a least-squares sense most closely approaches the specified desired response. It is shown that M.A.E. can be applied to nonlinear and/or time-varying systems as well as linear constant-coefficient systems. For all these classes of systems, M.A.E. has the advantage of requiring much simpler calculations than alternative procedures. A critical review and comparison of relevant alternative optimization procedures are given, and it is shown that none of these are equivalent to M.A.E. Author (TAB)

N68-23680# Electrotechnical Lab., Tokyo (Japan).
METHODS FOR PRECISION MEASUREMENT OF MICROWAVE IMPEDANCE AND MICROWAVE IMPEDANCE STANDARDS
Takeshi Tamaru Oct. 1967 66 p refs In JAPANESE; ENGLISH summary *Its* Res. No. 674
CFSTI: HC $3.00/MF $0.65

Two methods, using a magic T as a bridge element, and sliding short circuit for reference impedance, are described for high precision measurement of microwave impedance by which arbitrary unknown reflection coefficients can be measured. Based on the general response of the impedance measuring circuit using a four arm waveguide junction and a reference impedance, a detailed analysis was performed on a measurement technique which consists of a closely coupled generator and detector. From the analysis, methods of adjusting the measuring circuit for compensating the non-ideal properties of the magic T are developed, and the errors of measurement are evaluated. Other methods of measurement examined include, an unbalanced bridge method using a magic T with two auxiliary tuners. For the standard impedances adjustable sliding terminations are made for the standard of zero reflection, and quarter guide-wavelength short is made for the standard of total reflection. B.S.D.

N68-23930# Technisch Documentatie En Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).
AUTOMATION AND REMOTE CONTROL ON SHIPS. A SELECTIVE BIBLIOGRAPHY, 1961–1967
H. Amelink, comp. Feb. 1968 74 p refs
(TDCK-49991) CFSTI: HC $3.00/MF $0.65

This bibliography is on the electronic aspects of ship automation. It refers to the period 1961–1967 and contains some entries relegated into the chapters: general information, including reliability and economic aspects; automation of the engine room; automation of the shipboard electric power plant; automation of deck apparatus; data logging systems; electronics on warships; and related subjects. Author

N68-24144 Iowa State Univ. of Science and Technology, Ames.
CONTROL DESIGN FOR A CRYOGENIC FLUID STORAGE AND SUPPLY SYSTEM
Dattatraya Vithoba Kamat (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-2079

A mathematical study was made of the control design for a cryogenic fluid storage and supply system. The physical system was conceived as a spherical, heavily-insulated container in which oxygen is stored at cryogenic temperatures and supercritical pressures. Electrical heaters inside the container automatically provide energy to maintain system pressure as oxygen is removed. Non-linear partial differential equations are necessary to adequately describe the transient behavior of the physical system. Direct digital solutions and approximate analytical solutions of these equations were obtained. The factors which could cause a sudden loss of system pressure were identified and related to operating parameters. As a result of the study, recommendations are made regarding the location and capacity of heaters, the operating pressure, the oxygen withdrawal location, the permissible rate of oxygen use, and the suitability of on–off pressure control. Dissert. Abstr.

N68-24222 Lincoln Lab., Mass. Inst. of Tech., Lexington.
TIME OPTIMAL CONTROL FOR A CLASS OF COMMON RANDOM DISTURBANCES
Norval P. Smith 2 Feb. 1968 28 p refs
(Contract AF 19(628)-5167)
(ESD-TR-68-11; TR-442; AD-667521)

The report concerns the time optimal control of a system variable where the controlling input to the system is bounded, as is normally the case in practice. Optimal control is defined here as that control which yields time optimal trajectories. It is shown that time optimal control also yields optimal trajectories in the sense of minimizing the maximum error (if this is the initial error, minimize the overswing next) and the number of oscillations. The problem of optimal control of a second-order system initially in equilibrium and subjected to a large class of commonly occurring random disturbances is solved. Disturbances are considered to be controllable or uncontrollable. The broad class of random disturbances treated herein may have initial nonequilibrium values and consist of a unidirectional uncontrollable portion, followed by a controllable portion of sufficient duration to enable an optimal controller to bring the system to equilibrium. A single control function is derived which suffices to yield optimal trajectories. Author (TAB)

N68-24342# Royal Aircraft Establishment, Farnborough (England).
ON SOME NUMERICAL METHODS FOR THE CALCULATION OF THE TIME BEHAVIOUR OF A NETWORK [UEBER EINIGE NUMERISCHE VERFAHREN ZUR BERECHNUNG DES ZEITVERHALTENS VON NETZWERKEN]
W. Entenmann and M. Welzenbach Jan. 1968 21 p refs Transl. into ENGLISH from NTZ–Nachr. Tech. Z. (Brunswick), v. 20, no. 8, 1967 p 479–483
(RAE-LIB-TRANS-1283) CFSTI: $3.00

Three procedures are given to calculate the time behavior of linear transmission systems with lumped, time-invariant elements, provided that the input-time-function at discrete points and the action function of the transmission system are given by the location of the poles and zeros in the complex frequency plane. The numerical methods are mainly used in connection with time functions having no analytically expressible spectrum, e.g. at the output of limiter and rectifier circuits, and in connection with systems of very high degree. The first procedure uses Simpson's method for the evaluation of the convolution integral containing the input-time-function and the pulse response of the network. In the second and third procedure the action function is broken up into elementary action functions of degree one; the time behavior of each is described by a different equation of degree one. For the solution of this differential equation a recurrence formula is used in the second procedure, and Runge–Kutta's method is applied to the third one. An example is given in order to compare the accuracy of the different procedures and to discuss their advantages and disadvantages. In conclusion the practical application of the given formulas to the transmission and demodulation of frequency modulated signals is shown by an example. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-23047 Aerospace Corp., El Segundo, Calif. Lab. Operations.
VAN NORMAN LAKE MAGNETOMETER FACILITY, MAY–JUNE 1967
Wallace B. Harbridge and Donald A. McPherson Jan. 1968 19 p
(Contract F04695-67-C-0158)
(TR-0158(9220-02)-5; SAMSO-TR-68-96; AD-666660)

The report discusses the design and operation of a triaxial magnetometer facility developed for the Aerospace Corporation solar observatory at Van Norman Lake, California. Magnetometer sensors and associated electronics measure three components of the geomagnetic field. Fluctuations of the field (plus or minus 100 gamma) are recorded on a continuous basis at a recorder sensitivity of 2 gamma/mm. Author (TAB)

N68-23200# California Univ., Berkeley. Lawrence Radiation Lab.
AXIAL INJECTION STUDIES ON THE 88 INCH CYCLOTRON: HOLE LENS
Alfredo U. Luccio 2 Jan. 1968 11 p refs
(Contract W-7405-ENG-48)
(UCRL-18016) CFSTI: HC$3.00/MF$0.65

In order to improve the axial injection system of the 88-inch cyclotron a study was undertaken on the motion of injected particles through the magnetic field in the cyclotron upper pole hole. The magnetic field through the hole was measured and the trajectories of protons and deuterons were calculated in this resulting strong magnetic hole lens. NSA

N68-23209# Aeronautical Research Council (Gt. Brit.)
ON THE EQUILIBRIUM PISTON TECHNIQUE IN GUN TUNNELS
L. Davies, J. D. Regan, and K. A. Dolman London HMSO 1968 31 p refs Supersedes NPL-AERO-1240, ARC-29308
(ARC-CP-982; NPL-AERO-1240; ARC-29308) CFSTI: HC $3.00/MF$0.65

The use of the equilibrium piston technique in gun tunnels is discussed. Details of a simple theoretical formula for the calculation of ideal piston weight are given together with results of experiments performed in the NPL 2 in. gun tunnel using 20 and 25 gm pistons. Author (ESRO)

N68-23357*# Stevens Inst. of Tech., Hoboken, N. J.
A LABORATORY SCALE MODEL TECHNIQUE FOR INVESTIGATING PNEUMATIC TIRE HYDROPLANING
H. Dugoff and I. R. Ehrlich Washington NASA May 1968 39 p refs
(Contract NSR-31-003-016)
(NASA-CR-1074; Rept.-1223) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A new technique is developed for laboratory investigation of pneumatic-tire hydroplaning through experiment with small-scale tires on a treadmill runway-simulator. The tires are mounted on a modified aircraft-landing-gear assembly which permits freedom in heave under variable vertical load and allows measurement of the longitudinal force exerted on the tire. The treadmill is capable of speeds up to 90 feet per second, and is outfitted with a water-supply system and a nozzle which delivers a water layer 1-foot wide, of variable thickness, at matching speed. The model tires are fabricated of polyurethane foam the density of which is varied to simulate variations in pneumatic-tire inflation pressure. Correlation of detailed load-deformation data for model and prototype tires demonstrates that geometric similarity is achieved under static conditions. Dimensional analysis has been employed to derive additional requirements for dynamic similarity and to develop a design for the initial series of experiments. Author

N68-23413# McGill Univ., Montreal (Quebec). Space Research Inst.
AEROSPACE APPLICATION OF GUN LAUNCHED PROJECTILES AND ROCKETS
Charles H. Murphy (Aberdeen Proving Ground) and Gerald V. Bull Feb. 1968 42 p refs Presented at Am. Astronautical Soc. Symp. on Future Space Programs and Impact on Range Network Develop., Paper No. 67-38, University Park, N. Mex., Mar. 1967 Sponsored by Aberdeen Proving Ground
(SRI-R-24; AD-666746)

Project High Altitude Research Program (HARP) is directed toward the use of guns for scientific probing of the upper atmosphere. The attractive features of guns for this purpose are the basic economy of such a system and the high inherent accuracy of guns for placement at altitude as well as accuracy in ground impact. The basic liability for such an approach lies in the very high accelerations experienced by gun-launched payloads. The guns used in Project HARP vary in size from 5-inch and 7-inch extended guns on mobile mounts to transportable fixed 16-inch guns. Altitude performance varies from 20 pound, 5-inch projectiles reaching 240,000 feet to 185-pound, 16-inch projectiles reaching 590,000 feet. Scientific results to date are primarily wind profiles measured by radar chaff, aluminized balloons and parachutes, and tri-methyl-aluminum trails, although a number of successful 250 MHz and 1750 MHz telemetry flights have been made. Author (TAB)

N68-23535*# Techtran Corp., Glen Burnie, Md.
AIR COOLER FOR HYPERSONIC WIND TUNNELS [VOZDUKHOOKHLADITEL' DLYA GIPERZVUKOVYKH AERODINAMICHESKIKH TRUB]
Ye. N. Bogdanov, A. U. Lipets, and V. Ye. Chekalin Washington NASA May 1968 3 p Transl. into ENGLISH from Izobret., Prom. Obraztsy, Tovarnyye Znaki (USSR), no. 15, 1967 p 31–33
(Contract NASw-1695)
(NASA-TT-F-11697) CFSTI: HC$3.00/MF$0.65 CSCL 13A

A patent was issued for an air cooler for hypersonic wind tunnels consisting of an outer housing, heat lens equalizers, a water intake and output system, and a water cooling element made of metal pipes arranged parallel to the flow. Efficiency and reliability are increased by welding the intake side of the cooling element to the diffuser-output section of the wind tunnel, and welding the output section of the air cooling element across the prestressed (stretched) equalizer to the air cooler's outer housing; the output flange of the diffuser is welded across the lens equalizer part of the air cooler housing without prestressing the equalizer. Overheating of the outer part of the diffuser is decreased by feeding water in discrete, pressure driven streams through an injector pipeline. Author

N68-23537*# Techtran Corp., Glen Burnie, Md.
DIFFUSER WITH CONICAL AND STEPPED CHANNEL EXPANSION FOR REDUCING GAS FLOW VELOCITY [DIFFUZOR DLYA PONIZHENIYA SKOROSTI GAZOVOGO POTOKA S KONICHESKIM I STUPENCHATYM RASSHIRENIYEM KANALA]
Yu. K. Arkodov, V. S. Yelkin, and M. P. Ryabokon Washington NASA May 1968 2 p Transl. into ENGLISH from Izobret., Prom. Obraztsy, Tovarnyye Znaki (USSR), no. 9, 1967 p 138–139
(Contract NASw-1695)
(NASA-TT-F-11698) CFSTI: HC$3.00/MF$0.65 CSCL 14B

A patent was issued for a diffuser with a conical and stepped channel expansion designed to reduce gas flow velocity. The diffuser contains a grid in the section behind the stepped channel expansion. The grid is the same size as the diffuser opening before the stepped channel expansion, in order to improve the uniformity of the exit velocity field at high subsonic inlet velocities in the diffuser. The hydraulic drag coefficient of the grid is eight. Author

N68-23555# Stanford Univ., Calif. Electronics Labs.
FEASIBILITY STUDY OF AN AUTOMATED, UNMANNED GEOPHYSICAL OBSERVATORY FOR OPERATION IN ANTARCTICA
Jon A. Jenny and William F. Lapson Feb. 1968 150 p refs
(Grant NSF GA-1195)
(SU-SEL-68-010; TR-3433-1; PB-177593)

The concept of an unmanned automated geophysical observatory emerged several years ago as a plausible alternative to manned stations for Antarctic research. The principal motivating factor for this concept was the continuing burden of high cost and great effort associated with life support in manned stations. The fact that automated laboratories, similar in function and complexity to their Antarctic counterparts, were already successfully completing missions in space made the concept appear feasible. Author (PB)

N68-23616 European Organization for Nuclear Research, Geneva (Switzerland). Intersecting Storage Rings Div.
ACCELERATOR RESEARCH AT CERN, 1956–1967
M. J. Pentz 12 Mar. 1968 23 p refs
(CERN-68-9)

An historical account is presented on the achievements of the acceleration physics research and technology group. These are cited as (1) the design, construction, and operation of the proton synchrotron which served as the basis for the detailed design of the 300 GeV accelerator; (2) the intersecting storage ring which resulted from early consideration of colliding beam devices; (3) the construction and operation of the CERN electron storage and accumulation ring; (4) beam manipulation and observation techniques; and (5) advanced spark chamber devices and such associated techniques as fast pulse devices and image intensifiers. In critically evaluating these past achievements, which marked the 11-year period of the group's existence, the point is made that the effects cannot be expressed solely in terms of experimental and theoretical results. The new people attracted to the program, and the close contacts developed with similar groups in Europe, the United States, and the Soviet Union are considered important in the context of expanding scientific cooperation. M.G.J.

N68-23622# California State Div. of Highways. Materials and Research Dept.
A STUDY OF THE PENNSYLVANIA STATE DRAG TESTER FOR MEASURING THE SKID RESISTANCE OF PAVEMENT SURFACES Final Report
J. Skog May 1967 17 p refs
(MR-633251; PB-177485)

This report covers the California Division of Highways' attempt to determine the degree of correlation between the Penn State Drag Tester and the California skid tester. No further study is proposed on this project since the correlation between the two testers was not satisfactory. Author (PB)

N68-23684# Naval Research Lab., Washington, D. C. Linac Branch.
REPORT OF LINAC OPERATION Interim Report, 1 Jul.–31 Dec. 1967
Jan. 1968 20 p
(NRL-MEMO-1860; IR-5; AD-667714)

The operation and use of the NRL 60 MeV Electron Linear Accelerator is described for the period 1 July - 31 December 1967. This period is characterized by increased use, to 1732 hours, by conversion to the Stanford (SLAC) type klystrons, and by installation of higher power, more reliable modulators. Non-Linac Branch users from nine separate groups received 18% of the beam time. Brief progress reports of six Linac Branch experiments are included. Author (TAB)

N68-23713# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
THE GAMMA IRRADIATION FACILITY ON THE HARWELL LINAC
C. A. Baker, P. P. Thomas, and D. R. Williams Nov. 1967 17 p refs
(AERE-R-5591) HMSO: 4s

Gamma irradiation using photons of up to 45 MeV is now a routine operation. This report describes the installation at the Harwell linac which has been built for this purpose, and gives details of the operation and performance. Author

N68-23744# Advisory Group for Aerospace Research and Development, Paris (France). Fluid Dynamics Panel.
EXPERIMENTAL METHODS IN WIND TUNNELS AND WATER TUNNELS, WITH SPECIAL EMPHASIS ON THE HOT-WIRE ANEMOMETER
K. Wieghardt (Hamburg Univ.) and J. Kux (Hamburg Univ.) Aug. 1967 50 p refs
(AGARD-558) CFSTI: HC $3.00/MF $0.65

A brief is presented on the experimental techniques used in low speed wind tunnels, towing tanks, circulating water channels, water tunnels, and cavitation facilities, with special emphasis on the use of the hot-wire anemometer. Author

N68-23797# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE ESTABLISHMENT AND UTILIZATION OF FILM DOSIMETER PERFORMANCE CRITERIA
C. M. Unruh, H. V. Larson, T. M. Beetle, and A. R. Keene Sep. 1967 209 p refs
(Contract AT(45-1)-1830)
(BNWL-542) CFSTI: HC $3.00/MF $0.65

The need for the establishment of a central calibration laboratory for processors of film dosimeters is discussed. It is pointed out that in 1967 at least 15 commercial firms in the United States offered film dosimeter processing and evaluation service, while an even greater number of AEC prime contractors and military installations operated their own film dosimeter services. Criteria for acceptable levels of performance are discussed. An evaluation of the performance level of film dosimeter processing demonstrated a wide spectrum of performance levels. It was concluded that a program that would provide an assessment of the quality of film processing services is very desirable. It is recommended that evaluation programs may be enhanced by the establishment of a central calibration laboratory. Cost estimates for a calibration laboratory are included. NSA

N68-23817# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIAGRAM FOR CALCULATION OF PARALLEL CONNECTIONS OF A VENTILATION NET [DIAGRAMMY DLYA RASCHETA PARALLEL'NYKH SOYEDINENIY VENTILYATSIONNYKH SETEY]
R. Ya. Vassel' *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 15–19 (See N68-23814 13-15)

The article describes the development of a graph to be used for computing construction of parallel connections of a ventilation net. The diagram permits using the resistances of separate branches for a rapid and simple determination of the total resistance of a system, total amount of air which will flow along the connection at a given depression, and the quantity of air in separate branches. Author

N68-23818# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF MAXIMUM ACCELERATION DURING STARTUP OF FAN [OPREDELENIYE MAKSIMAL'NOGO USKORENIYA PRI PUSKE VENTILYATORA]
P. A. Voronin *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 21–26 refs (See N68-23814 13-15)

The article directs attention to the problem of selection of electric motors for ventilating fans for mines. Characteristics of moments of resistance of fans are precisely expressed by the formula provided and the analytic method for calculating maximum angular accelerations is preferable to a graphoanalytical method. Author

N68-23852# Air Force Missile Development Center, Holloman AFB, N. Mex.

PREDICTED FORCING FUNCTIONS AND FORCE MEASUREMENTS ON AN OUTRIGGER ROCKET SLED TRAVELING THROUGH A BLAST ENVIRONMENT

Daniel J. Krupovage Dec. 1967 27 p refs

(MDC-TR-68-4; AD-667514)

A technique was developed for predicting the aerodynamic forcing functions acting on an outrigger rocket sled as it traversed a blast environment. This technique was programmed on the CDC 3600 computer. In order to computerize the technique, the time histories of the blast parameters were approximated by first and third order polynomial equations. The sled trajectory was transformed into the scaled time and distance coordinates of the blast parameters. The steady state aerodynamic coefficients as a function of Mach number obtained from wind tunnel tests were approximated by third order polynomials. These steady state coefficients were used at discrete times to define the aerodynamic forces acting on the vehicle as it traversed the blast environment. The report also describes the load transducer used to measure the lateral forces acting on the front slipper of the outrigger rocket sled. The time history of these measured forces and lateral acceleration data are discussed. A maximum force on the front slipper of 76,000 pounds was recorded on one of the runs. Also included is information on the vehicle structural vibration frequencies, which was obtained from reduction of test data in the form of power spectral density. Author (TAB)

N68-23971# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.

MODIFICATIONS TO THE RHEL GEOMETRICAL RECONSTRUCTION PROGRAM

J. W. Burren and E. C. Sedman Sep. 1967 38 p

(RHEL/R-150) CFSTI: HC $3.00/MF $0.65

Improvements made to the R.H.E.L. geometrical reconstruction program for bubble chamber tracks are described. Author (NSA)

N68-23974# Naval Civil Engineering Lab., Port Hueneme, Calif.

MEASUREMENT OF AIRFIELD MARKING PAINT FLEXIBILITY

Eddy S. Matsui and Richard W. Drisko Mar. 1968 21 p refs

(NCEL-TR-568; AD-667234) CFSTI: HC $3.00/MF $0.65

A method for determining the elongation of free paint films is discussed. The method is more precise than the ASTM and Federal Test Standard methods which use the mandrel test, and it provides a more clear-cut differentiation between different coating films. A statistical analysis was performed on 10 experimental airfield marking paints using data from the free-film percent-elongation tests and from performance tests of the same coatings exposed in the field. The results indicate that there is a definite correlation between the percent elongation (flexibility) and the field performance of airfield marking paints. Author (TAB)

N68-24042# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

APPARATUS FOR CONTINUOUS SOLIDS-LIQUID SEPARATION, JANUARY–MAY 1967

Michael J. Ryan Feb. 1968 11 p refs

(SAM-TR-68-10; AD-667795)

An apparatus has been developed which allows high filtration with a Millipore filter on a continuous basis. The apparatus consists of a Plexiglas box built around a Millipore filter holder. The entrance port in the box contains a nozzle which increases the velocity of the incoming solution and directs it into a tangential flow pattern, thus simultaneously supplying the mixture to be filtered as well as washing the filter clean of separated solids. Filtrate containing only particles smaller than 0.45 microns in diameter can be recovered continuously at a rate of 100 ml. per hour. Author (TAB)

N68-24052# Bell Aerosystems Co., Buffalo, N. Y.

STUDY, SURVEY OF HELICOPTER AND V/STOL AIRCRAFT SIMULATOR TRAINER DYNAMIC RESPONSE. VOLUME 3: SUGGESTED GUIDE FOR A FUNCTIONAL TEST SPECIFICATION FOR HELICOPTER AND V/STOL AIRCRAFT FLIGHT TRAINERS Final Report

H. G. Streiff Orlando, Fla. Naval Training Device Center Jun. 1967 84 p refs

(Contract N61339-1753)

(NAVTRADEVCEN-1753-3; AD-667722)

The report contains a summary of the results of a study to determine the dynamic response criteria for helicopter and V/STOL aircraft simulator trainers, and provides a guide to be used by the government in the preparation of a functional test specification for helicopter and V/STOL aircraft simulator trainers. Author (TAB)

N68-24163*# National Aeronautics and Space Administration, Washington, D. C.

MANNED SPACECRAFT CENTER, HOUSTON, TEXAS

1968 4 p

(NASA Facts 0-9/10-67) GPO: HC $0.15; CFSTI: MF $0.65 CSCL 22D

The Manned Spacecraft Center at Houston, Texas serves as a focal point for the manned space flight program. Its prime responsibilities are: (1) developing the technology required for manned spacecraft in present and future programs; (2) industry management during design, development, and fabrication of spacecraft for on-going programs; (3) selection and training of astronauts; (4) control over NASA manned space flights from time of launch until the accomplished landing; and (5) management of the medical, scientific, and engineering experiments conducted during manned space flights. G.G.

N68-24164*# National Aeronautics and Space Administration, Washington, D. C.

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA

1968 4 p

(NASA Facts 0-10/12-67) GPO: HC $0.15; CFSTI: MF $0.65 CSCL 22D

Briefly described are research and development operations at the Marshall Space Flight Center at Huntsville, Alabama. The prime responsibilities of this center at the development of large launch vehicles and spacecrafts for deep space and near earth missions as well as studies of future space exploration projects. G.G.

N68-24177# European Space Technology Center, Noordwijk (Netherlands).

SOLAR CELL PANEL TEST FACILITY ESRO-1 PANEL MEASUREMENT

A. W. Preukschat and G. Seibert Paris ESRO Sep. 1967 30 p refs

(ESRO-TN-9(ESTEC)) CFSTI: HC $3.00/MF $0.65

This paper describes the ESTEC test facility for testing solar cell modules and arrays. The facility consists essentially of a bank of tungsten iodine lamps, an infrared-absorbing water filter, and a movable, temperature-controlled test mounting. The spectral distribution of the light is given and related to absolute intensity. Performance measurements on an ESRO-1 solar cell panel are

described, and the results are compared to the specifications. The temperature coefficient of the short circuit current and open circuit voltage of one module was measured, and differences between the temperature coefficient of the short circuit current under the test light and that given for AMO equivalent filtered Xenon illumination are discussed. Author (ESRO)

N68-24209# Bureau of Mines, Amarillo, Tex. Helium Research Center.
ELASTIC PRESSURE DISTORTION OF THE VOLUMES OF A BURNETT COMPRESSIBILITY APPARATUS OVER THE TEMPERATURE RANGE 0° TO 80°C
Ted C. Briggs and Robert E. Barieau Jun. 1968 37 p refs
(BM-RI-7136)

Equations for the elastic pressure distortion of the volumes of a Burnett compressibility apparatus are developed and presented in this report for volumes under internal and external applied pressures. An experimental method for the determination of the external pressure distortion coefficients is presented. Young's modulus and the internal pressure distortion coefficients are computed from the experimentally determined external pressure distortion coefficients. The temperature dependence of the pressure distortion coefficients and of Young's modulus is evaluated for the temperature range 0° to 80°C. Author

N68-24235# Coordination des Techniques Industrielles, Paris (France).
SITING OF RADIOACTIVE WASTE STORAGE FACILITIES WITHIN THE EUROPEAN COMMUNITY [SITOLOGIE DU STOCKAGE DES DECHETS RADIOACTIFS DANS LA COMMUNAUTE EUROPEENNE]
G. Grison, H. Krause, P. Ch. Leveque, and F. Pantane Brussels EURATOM Feb. 1968 70 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-007-65-3 WASF)
(EUR-3664.F) CFSTI: HC $3.00/MF $0.65

On the basis of the rate of development of electrical energy obtained from nuclear sources it may be estimated that by the year 2000 it will be necessary to store a total of 3,000 metric tons of waste fission products, with a residual activity at that date of about 300,000 million curies. The aim of the study to pinpoint the regions in the European Atomic Energy Community capable of accommodating storage facilities for radioactive waste. Described is an original method based on the superposition of colored maps. Each map represents a parameter. The color range for each map is such that a light color corresponds to areas in which the parameter has a favorable value while darker colors indicate the less favorable areas. Superposition of the colored parametric maps provides a synthetic map in which the chromatic integration reveals the regions which are theoretically suitable sites for storage facilities. A classification of the criteria is also proposed. Suggestions are put forward for applying the method to industrial, economic or social problems, in a great variety of combinations. Author

N68-24265# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik.
STUDIES ON A SUPERCONDUCTING PROTON LINEAR ACCELERATOR iN GEV RANGE [STUDIE UEBER EINEN SUPRALEITENDEN PROTONEN-LINEARBESCHLEUNIGER IM GEV-BEREICH]
Jul. 1967 236 p refs In GERMAN
(NP-17272)

A proposal for the construction of a superconducting proton linear accelerator in the GeV range is presented. The report was prepared to serve as the basis for further experimental and theoretical studies. The scientific principles on which the accelerator is based are reviewed. Preliminary design parameters of the accelerator are given. Cost studies and construction plans are briefly described. NSA

N68-24313# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fuer Angewandte Gasdynamik.
DEVELOPMENT OF A TEST APPARATUS FOR THE PRODUCTION AND OBSERVATION OF FLUID IMPLOSIONS UNDER EXTREME CONDITIONS [ENTWICKLUNG EINER VERSUCHSAPPARATUR ZUR ERZEUGUNG UND BETRACHTUNG VON FLUESSIGKEITSIMPLOSIONEN UNTER EXTREMEN BEDINGUNGEN]
Wolf Trommsdorff and Kurt Gruemmer Feb. 1968 53 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-09; DVL-710) CFSTI: HC $3.00/MF $0.65

The implosion of fluid is the concentric fall in of a cavity, enclosed by a fluid. In its last phase this cavitation called process leads to high densities of energy in the direct surrounding of the disappearing bubble. In order to obtain extremely high densities of energy accompanied by extreme states of matter a high pressure autoklav has been conceived and built, in which the implosion is initiated by a short-time transfer of kinetic energy to the fluid. The tests and the results are described. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-23045# Wisconsin Univ., Madison. Mathematics Research Center.
ON HEAD SEAS TRAVELLING ALONG A HORIZONTAL CYLINDER
F. Ursell Aug. 1967 31 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-811; AD-666612)

It is shown that, on the usual assumptions of linearized theory, head seas cannot travel along a horizontal cylinder without change of form. Author (TAB)

N68-23051 Tulane Univ., New Orleans, La.
THE NUMERICAL SOLUTION OF EQUATIONS DESCRIBING AN UNSTEADY DRAINING PROCESS
Daniel Bernard Killeen (Ph.D. Thesis) 1966 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-3852

The numerical solution of equations describing an unsteady draining process is approached using finite difference techniques. The system of equations solved is in three dimensions, two space and one time. The boundary conditions for the system are split and, in addition, one boundary condition must be assumed and iterated upon at the surface of the reservoir. An additional complexity of the problem is that the position of the liquid-vapor interface is moving and its position must be solved as an integral part of the problem. The techniques of solving for this moving boundary are explored in this dissertation as well as methods for assuming boundary conditions. Dissert. Abstr.

N68-23104# General Applied Science Labs., Inc., Westbury, N. Y.
THE ADDITION OF SECONDARY SHOCK CAPABILITY AND MOFIDICATIONS TO THE GASL THREE-DIMENSIONAL CHARACTERISTICS PROGRAM. PART 2: USER'S AND PROGRAMMER'S MANUAL Final Report, Apr. 1966–May 1967
Gertrude Weilerstein 16 Aug. 1967 377 p refs
(Contract DA-01-021-AMC-14889(Z))
(GASL-TR-653, Pt. 2; AD-666742)

The report is the Users and Programmers Manual for the complete set of IBM 7090/94 programs which calculate the flow field about spherically tipped and pointed bodies at angles of attack, with an option for secondary shocks caused by flares. Included are a description of the program, inputs, outputs and operational procedures. Author (TAB)

N68-23174# Aeronautical Research Council (Gt. Brit.)
THE LOCAL PRESSURE FIELD OF TURBULENT JETS
P. O. A. L. Davies (Southampton Univ.), N. W. M. Ko (Southampton Univ.), and B. Bose (Southampton Univ.) London HMSO 1968 32 p refs Supersedes ARC-29065
(ARC-CP-989; ARC-29065) CFSTI: HC $3.00/MF $0.65

The characteristics of the pressure field associated with the turbulent shear flows of a jet have been studied in some detail. Components of the field in the potential core appear to be moving with a phase velocity equal to the local speed of sound in directions roughly normal to the shear layer. Some components of the hot wire signal can be associated with the jet structure as a single complex source while others are related to the local characteristics of the turbulence. An estimate of the strength of the fluctuating pressure field throughout the whole region of the jet flow is presented. Author (ESRO)

N68-23256# Navy Underwater Sound Lab., New London, Conn.
AN ANALYSIS OF THE EFFECT OF A POLYMER ADDITIVE ON TURBULENT WALL FRICTION AND PRESSURE FLUCTUATIONS
Frank M. White 29 Dec. 1967 68 p refs
(USL-881; AD-666818)

The analysis first shows that flat plate drag reduction by polymers is also due merely to the thickening of the sublayer. Even though the plate friction decrease can be very large, the study then shows that the turbulent wall pressure is almost unaffected by the presence of the additive. The calculations of flow noise reveal that the additive has much the same effect as a favorable pressure gradient in Newtonian flow, namely, almost no change in mean pressure level but a small increase in the convection speed and the longitudinal correlation length. Tables and graphs show the estimated effect of various polymers on both friction and turbulent wall pressure. Author (TAB)

N68-23275# Naval Ship Research and Development Center, Washington, D. C. Aerodynamics Lab.
EFFECT OF AN AMBIENT TURBULENCE COMPONENT ON MODEL CARRIER TURBULENCE DATA
Stavros Loezos Aug. 1967 22 p refs
(NSRDC-2561; AERO-1131; AD-666958)

Tests were performed to examine the manner in which various components of induced turbulence combine. Ambient or background turbulence created in the wind tunnel with a grid of cylinders interacted with the turbulence induced by a model aircraft carrier in the wind tunnel. The interaction of the turbulence components was studied with the objective of developing methods of removal of the ambient turbulence component from the total component of turbulence. The method for the removal of ambient turbulence is being developed for application in the full-scale aircraft carrier turbulence program. Author (TAB)

N68-23278# Wisconsin Univ., Madison. Mathematics Research Center.
NUMERICAL STUDY OF THE NAVIER STOKES EQUATIONS IN THREE DIMENSIONS
Padam Jain Mar. 1967 88 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-751; AD-666604)

To investigate the process of energy transfer from large eddies to smaller ones at high Reynolds Numbers, a finite difference method is used to obtain the periodic solutions of the Navier-Stokes equations in three dimensions when the initial motion is assumed to be v sub 1 = cos x sin y sin z, v sub 2 = -sin x cos y sin z, v sub 3 = 0. A numerical technique for the solution of Poissons equation for the three dimensional problem is described and used for the solution of the problem. Mean kinetic energy and mean square vorticity are calculated and it is found that the numerical method provides estimates of these quantities up to a time of the order of 2. The structure of the turbulent flow is investigated by a study of the velocity correlation function R sub ij. Author (TAB)

N68-23287*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
GAS ANALYSIS WITH PULSED VACUUM NETWORKS
B. R. F. Kendall and R. E. Pulfrey [1967] 14 p refs Presented at the 4th Intern Vacuum Congr., Manchester Univ., Engl., 17–20 Apr. 1968
(Grant NGR-39-009-015)
(NASA-CR-94530) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A molecular-flow network theory applicable to volumes interconnected by small orifices or porous membranes is discussed. Parameters which describe the properties of such orifices and membranes are defined. The basic theory is then extended to cover various cases of pulsed operation with mixtures of gases having different molecular weights. The mass-dependent impedance of an orifice or porous membrane makes it possible to use molecular-flow networks as gas analyzers. Experiments with molecular-flow networks at pressures up to 100 Torr are summarized. A simple automatic measurement of the pressure in a pulsed network can give the effective molecular weight of a gas sample with an accuracy of a few parts per thousand. More elaborate computer analyses of output pressure waveforms appear capable of giving at least semiquantitative information about the molecular weights and partial pressures of the various gases present. Instruments of this type may be useful for analysis of planetary atmospheres. Author

N68-23337# Stanford Univ., Calif. Dept. of Mechanical Engineering.
INVESTIGATION OF A TWO-DIMENSIONAL FULLY STALLED TURBULENT FLOW FIELD
Granger Chui and Stephen J. Kline Aug. 1967 178 p refs
(Contract AF 49(638)-1278)
(MD-19; AFOSR-67-2047; AD-666931)

The bistable, steady, turbulent separation phenomenon observed in a two-dimensional fully-stalled diffuser is studied. Detailed mean flow data including pressure, dissipation and velocity (both magnitude and direction) inside the flow field as well as development of boundary layers on both side walls are reported for cases with thin and thick boundary layers at inlet and with and without fairing curves at the throat. For all cases, most important changes in flow data occur in a region within two inlet widths up and downstream of the throat. Pressure gradients in this region are so large that the boundary layer on the unstalled side changes shape abruptly while the layer on the stalled side separates in the vicinity of the throat. Streamline patterns are obtained from the velocity distributions. The location of the dividing streamline is different for the different cases. Based on the dividing streamline, a displacement line is defined to extend the concept of displacement thickness to the free shear layer which is developed from the separated boundary layer. This displacement line together with the loci of boundary layer displacement thicknesses on the solid walls form an effective channel. The shape and area ratio of this effective channel explain the different trends of pressure distributions in the main flow. Author (TAB)

N68-23353*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CAPILLARY RISE IN THE ANNULAR REGION OF CONCENTRIC CYLINDERS DURING COAST PERIODS OF ATLAS CENTAUR FLIGHTS

Raymond F. Lacovic and James A. Berns Washington May 1968 14 p refs

(NASA-TM-X-1558) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The Centaur space vehicle liquid oxygen and liquid hydrogen tanks each contain a mass sensing system which utilizes flow through a helical inlet tube into a probe consisting of two concentric cylinders. During the coast periods of the Atlas-Centaur flights, each mass sensing system acted as a capillary system under low gravity conditions. Data for the capillary rise height in the annular region of concentric cylinders as a function of time were obtained from the flights of three Atlas-Centaurs at acceleration levels of approximately 7.0×10^{-3} and 4.2×10^{-4}g with durations of up to 100 and 1341 seconds, respectively. The capillary rise data were correlated with an analytical expression which accurately described the fluid flow through the sensing system under low gravity conditions. Author

N68-23362# Aerospace Corp., El Segundo, Calif.

THE NON SIMILAR BOUNDARY LAYER WITH BLOWING, JUNE–NOVEMBER 1967

William S. King Feb. 1968 44 p refs

(Contract F04695-67-C-0158)

(TR-0158(3240-10)-7; SAMSO-TR-68-97; AD-666913)

A generalized method is proposed for the numerical and analytical solution of non-similar boundary layer flows with fluid injection. For a given mass injection distribution and external pressure gradient, solutions can be obtained which do not depend on the magnitude of the injected flow rate. Instead, variations in the magnitude of the injected flow are associated with variations in a transformed tangential coordinate. The method is used to generalize a previously obtained numerical solution for the incompressible boundary layer flow over a flat plate with uniform mass injection to the compressible case, and to obtain a solution for the strong interaction of a hypersonic inviscid flow with the boundary layer on a flat plate with uniform mass injection. Numerical results in which the wall temperature is the only parameter are given for the latter case. It is shown that the injected mass flow tends to increase the induced pressure and displacement thickness, and to decrease the heat transfer and wall shear. The wall temperature has a significant effect on the dimensionless pressure and displacement thickness, and a smaller but noticeable effect on the dimensionless heat transfer and shear. Author (TAB)

N68-23380 Rensselaer Polytechnic Inst., Troy, N. Y.

A CONTINUUM APPROACH TOWARDS ANOMALOUS EFFECTS OF ULTRASONIC WAVE PROPAGATION

Julius A. Mirabal (Ph.D. Thesis) 1966 62 p

Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-4187

A theory is developed for ciscous heat conducting, homogeneous, isotropic fluids, including the constitutive dependence on the second gradient of the velocity, the time rates of change of the velocity and temperature, together with their appropriate coupling terms. Field equations of higher order than in the Navier–Stokes theory, together with sufficient boundary conditions, and the constitutive relations for stress and heat flux are derived with the use of a variational principle. The temperature and density dependence of the new material parameters introduced and numerical estimates of their values are obtained by application of the theory to the problem of ultrasonic wave propagation in a rarefied monatomic gas and by bringing the solution into "best" agreement with the available experimental data. Equations are presented for the computation of the sound modes and for the surface force on the receiving element in experimental apparatus. Dissert. Abstr.

N68-23418 Connecticut Univ., Storrs.

MASS TRANSFER AND PRESSURE DISTRIBUTION OF A FLUID FLOWING IN A FLEXIBLE WALLED RADIAL VENTURI

Stanley Burton Levy (Ph.D. Thesis) 1966 123 p

Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3899

The principle which has been investigated is the basis for a load carrying ground effect device which has a very high load capacity and requires a low power supply. The device under consideration is simply a flexible membrane attached to a rigid disk. A set of simultaneous differential equations was developed which would predict the membrane shape, minimum air gap distance, and pressure distribution, for various values of load and flow rate. These equations in their finalized state were a reduced form of the Navier–Stokes equations, and Prandtl's "Membrane Analogy" equation. These governing equations were solved numerically utilizing IBM 1620 and 7040 computers. An experimental program was carried out which verified the results obtained by the solution of the governing equations. Instability was studied experimentally, and a dimensionless flow parameter was developed as an instability criterion. This dimensionless group applies to rigid as well as flexible hydrostatic air bearings. Dissert. Abstr.

N68-23423*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECTS OF HIGH-WAVE AMPLITUDE AND MEAN FLOW ON A HELMHOLTZ RESONATOR

Bert Phillips Washington May 1968 21 p refs

(NASA-TM-X-1582) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An experimental investigation was conducted to determine the effects of mean flow and high-wave amplitude on the impedance of a Helmholtz resonator. The oscillatory phase and pressure relations across the aperture of a resonator were measured and converted into values of acoustic resistance and reactance. The results indicate that (1) the aperture effective length in a rocket-engine environment should be considered approximately equal to the aperture thickness and (2) the acoustic resistance at high-wave amplitude can be considered to be a turbulent jet loss. Author

N68-23482*# Douglas Aircraft Co., Santa Monica, Calif.

NARROW BAND CROSS-CORRELATION ANALYSIS OF FLUCTUATING PRESSURES BENEATH A TURBULENT BOUNDARY LAYER

C. M. Ailman and A. S. Hopkins Washington NASA May 1968 83 p refs

(Contract NAS1-6901)

(NASA-CR-1066; DAC-60874) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Selected narrow-band cross-correlations were calculated for pressure fluctuations at a rigid wall under both a uniform and a disturbed turbulent boundary layer at supersonic speeds. Flow disturbances resulted from: (1) a forward-facing step-spoiler, (2) an aft-facing step (with a well-behaved, slowly growing turbulent boundary layer prior to the step); and (3) an impinging (and reflected) shock generated by an obstruction to the airstream some distance from the wall. The data are presented in terms of contours of equal correlation coefficient, spatial decays of the correlation, and convection velocities. Author

N68-23519*# Techtran Corp., Glen Burnie, Md.

WALL FLOW AND UPWARD FLOW PRODUCED BY DEFLECTION OF FREE-STREAMS [WANDSTROMUNGEN UND AUFSTROME AUS DER UMLENKUNG VON FREISTRAHLGRUPPEN]

Heinrich Hertel Washington NASA May 1968 3 p Transl. into ENGLISH from Fortschr. Berichte VDI-z. (Germany), v. 108, no. 19, 1 Jul. 1966 p 816

(Contract NASw-1695)
(NASA-TT-F-11670) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The lift stream of VTOL-aircraft which take off vertically and land vertically (VTOL=Vertical Take-off and Landing) is directed downward for pure vertical movement. This stream direction, as opposed to that of the usual planes, entails a number of new flow patterns. Of special importance are the "ground effects" which occur when the VTOL-aircraft is on the ground or at low altitude. To make visible propagation and interference of the wall streams on the floor and the forming of flow reservoirs, from which upward flow occurs, petroleum-black-images were made. The streams, their afflux, their effect on each other, and the upward flow from the ground were examined in vertical planes with a process using light sections. Several methods are suggested to reduce upward flow. Author

N68-23556# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
DRAG COEFFICIENT OF A SLOWLY MOVING SPHERE IN NEAR-CONTINUUM FLOW
Nobunori Oshima 15 Mar. 1967 40 p refs
(Grants NSF GP-2366; NSF GP-5393)
(TR-19; PB-177390)

The calculation of the drag force on a slowly moving sphere in a gas is approached by the continuum theory. The Navier–Stokes and the Burnett equations are examined. The former is inapplicable, and the latter gives impossible results for smaller particles. By an alteration of the Burnett equation, a reasonable prediction is obtained. When the momentum accommodation coefficient is taken as 0.9, the predicted drag is very close to the Millikan empirical formula. Author (PB)

N68-23590* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
DYNAMIC FEATURES OF A SPHERICAL GAS BUBBLE IN FLUID [OSOBENNOSTI DINAMIKI CHERICHESKOGO GAZOVOGO PUZYRKA V ZHIDKOSTI]
V. K. Kedrinskiy Washington NASA May 1968 10 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 3, 1967 p 120–125
(Contract NASw-1962)
(NASA-TT-F-11653) CFSTI: $3.00 CSCL 20D

An analysis is made of a spherical gas bubble in both compressible and incompressible fluids. The movements of the bubble wall are analyzed in relation to pressure waves and conditions imposed by an incompressible fluid. The spherical symmetry of pulsations in a compressible nonviscous fluid is examined. Author

N68-23690# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
FLOW EXPERIMENTS ON PACKED BEDS USING THE UNIVERSITY OF ADELAIDE WATER TUNNEL
Sep. 1967 27 p refs
(AAEC/TM-398)

Experiments were carried out to determine pressure drop and flow distribution data for packed beds of spheres. Two randomly packed and two regularly packed beds were investigated. The preparation, assembly and testing of these sphere packings are described and the results analyzed and discussed. The friction factors for the two regular beds were found to be higher than for the two random beds. The agreement of the random bed data with that from similar studies is good. Flow profiles, except for the wall region, were essentially flat and independent of Reynolds number. Author (NSA)

N68-23732 Tennessee Univ., Knoxville.
NUMERICAL AND EXPERIMENTAL INVESTIGATION OF A TWO-DIMENSIONAL LAMINAR FLOW WITH NON-REGULAR BOUNDARIES
Eduardo Jose Tejeira (Ph.D. Thesis) 1966 241 p
Available from Univ. Microfilms: HC $11.05/MF $3.15 Order No. 67-1383

This dissertation describes the numerical solution of the complete, incompressible, steady state, Navier–Stokes equations obtained for a two-dimensional channel with a diverging section. An experimental verification of the results for low Reynolds numbers by means of birefringence measurements is also presented. The equations of motion were reduced to two second-order, elliptic, partial differential equations with stream function and vorticity as dependent variables. These equations were then transformed into their finite difference equivalents, and the resulting algebraic equations were solved numerically by over- and under-relaxed Gauss–Seidel iteration to obtain values of vorticity, stream function, velocities, and maximum strain rate over the flow field for Reynolds numbers of 1, 10, and 100. Dissert. Abstr.

N68-23738# Argonne National Lab., Ill.
ASYMPTOTIC SOLUTION OF EQUATIONS OF INCOMPRESSIBLE BOUNDARY LAYERS WITH A NEGATIVE PRESSURE GRADIENT AT STRONG INJECTIONS
V. N. Filimonov [1967] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (USSR), no. 5, 1967 p 48–52
(ANL-TRANS-576) CFSTI: HC $3.00/MF $0.65

During the entrance of bodies into the terrestrial atmosphere at high velocities the entrainment of the mass from the surface of the body caused by high convective and mainly by radiative currents can assume arbitrarily high values, i.e., the injection into the boundary layer can trend toward infinity. The solution of Prandtl equations for incompressible boundary layers with a negative pressure gradient ($dp/dx<0$) at strong injections is presented. The asymptotic solution obtained conforms with the exact numerical solution for such magnitudes of the injection where the approximation of the boundary layer is still applicable. A similar solution for automodel equations in the vicinity of the critical point has been obtained earlier. The application of the asymptotic solution permitted the determination of an expression for the friction coefficient which is convenient for concrete calculations in the case of arbitrary negative pressure gradients. Author (NSA)

N68-23784 Aerospace Corp., El Segundo, Calif. Technical Operations.
DETERMINATION OF FREE-MOLECULAR DRAG FOR A FLAT PLATE WITH A NORMAL PROTUBERANCE INCLUDING MULTIPLE SURFACE COLLISIONS, FEBRUARY–JUNE 1967
J. D. Stewart Oct. 1967 96 p refs
(Contract F04695-67-C-0158)
(TR-0158(3305)-1; SAMSO-TR-68-99; AD-667218)

The normal and shear forces are determined and the total drag is predicted for free-molecular flow over a two-dimensional flat plate with a normal protuberance emphasizing the effects of multiple surface collisions. The plate is aligned parallel to the flow and the protuberance is of infinitesimal thickness. A complete analysis is presented which includes all components of thermal motion. The gas particles are assumed to be diffusely reflected from the surfaces and completely accommodated to the wall temperature. The number densities required for the surface distribution functions are found by solving coupled Fredholm integral equations of the second kind using the collocation method. The contributions of the various components of drag are compared and several approximate methods for predicting the drag are presented. Finally, it is demonstrated that for large speed ratios the freestream contributions to the stresses and flux at the surfaces can be predicted quite well by neglecting the thermal motion of the particles in the freestream direction. Author (TAB)

N68-23847# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
A NUMERICAL EXPERIMENT ON A TURBULENCE MODEL
Aldo Giorgini Dec. 1967 125 p refs
(Grant DA-AMC-28-043-65-G20)
(CER67-68AG49; AD-667361)

Burgers equation is Fourier-analyzed to obtain a system of a discrete infinity of equations in a discrete infinity of variables. This system is studied numerically and the response to random initial conditions is obtained by use of a CDC 6600 digital computer. The 60 realizations obtained were used to obtain mean amplitudes, average energy spectra, skewness factors, flatness factors, and correlation functions. Author (TAB)

N68-23917# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
HOT-WIRE MEASUREMENTS OF TURBULENCE IN A THERMALLY STRATIFIED FLOW
S. P. S. Arya and E. J. Plate Feb. 1968 49 p refs
(Grant DA-AMC-28-043-65-G20)
(CEM67-68SPSA-EJP11; RM-11; AD-667395)

A technique is described in detail for measurements of turbulent fluxes and intensities in a thermally stratified boundary layer. It is a modification of a procedure first suggested by Kovasznay and further elaborated by Morkovin for determining turbulence in compressible fluid flows. The results are found to be consistent, but the technique is elaborate and time consuming. Author (TAB)

N68-23918# General Electric Co., Schenectady, N. Y. Research and Development Center.
CONVERGENT TRANSFER SCHEMES FOR N-PERSON GAMES
R. E. Stearns Sep. 1967 22 p refs
(Rept.-67-C-311)

A transfer scheme is described that converges to the kernel of a game and another scheme described that converges to the bargaining set. These convergences are established by a more general convergence result of which they are special cases. Author

N68-23943# General Electric Co., Philadelphia, Pa. Missiles and Space Div.
ELECTRON BEAM FLUORESCENCE STUDIES AND THEIR APPLICATION TO GAS DYNAMIC RESEARCH
E. P. Muntz *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 25 p refs (See N68-23931 13-34)

A discussion of the electron beam fluorescence technique, a new technique in experimental fluid physics, and its applications in the study of basic gas dynamic phenomena such as the study of shock wave structure, is presented. Described are the development of the technique and the mechanics of its operation; several current systems oriented research projects to which it is being applied; and basic gas dynamic research being accomplished using the technique. The technique can be used to obtain at any selected point in a gas flow the following parameters: static temperature, flow velocity, and specie concentrations. Flow quantities are measured directly so that no a priori knowledge of the flow history or the interaction of a probe with the flow environment is required. The most important feature of this method is that it makes direct point measurements of quantities that are otherwise extremely difficult to obtain in many flow situations. Significant contributions of the electron beam fluorescence technique to both systems oriented and fundamental gas dynamic research are described, and the use of this technique in studies of injection systems for observables control, turbulent wakes with and without injection; studies of the properties of high altitude, rarefied flow fields; in the analysis of reentry flow fields and the measurement of atmospheric properties; and in studies focusing on the measurement of velocity distribution functions is discussed. It is concluded that development of the technique will continue in numerous areas remaining to be investigated as the extension to new gases and gas mixtures, higher densities, chemically reacting flows and the measurement of velocity in polyatomic gases. S.C.W.

N68-24005# National Physical Lab., Teddington (England). Aerodynamics Div.
SIMILARITY SOLUTIONS IN SEVERAL TURBULENT SHEAR FLOWS
J. L. Robinson (Imperial Coll. of Sci. and Technol.) 3 Aug. 1967 17 p refs
(NPL-AERO-1242; ARC-29330) CFSTI: HC $3.00/MF $0.65

Following the work of A. A. Townsend, a similarity analysis is presented for flow in a turbulent boundary layer after a change of surface roughness a single-sided mixing layer developing from an initial boundary layer, and a double-sided wake developing from two initial boundary layers. Author (ESRO)

N68-24019 Maryland Univ., College Park.
TURBULENT, HIGH SCHMIDT NUMBER, ENTRY-REGION MASS TRANSFER IN ANNULI
James Otto Cermak (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-2376

Entry region and fully developed mass transfer from the inner core of annuli was investigated for a fully developed velocity profile and a Schmidt number of 760. Constant wall concentration was the satisfied boundary condition of the inner core. The ranges of parameters investigated were: Reynolds number: 21,400–75,600, annulus diameter ratio: 0.164–0.741, and length to hydraulic diameter ratio: 0.018–3.85. Experiments were performed in an open water flow loop. Mass transfer coefficients were obtained from weight loss measurements of benzoic acid "Life Saver" elements of various lengths. These elements were assembled as an integral part of the inner core of the annulus. Concentricity was maintained by a tensioning device. The local Sherwood number is found to be significantly affected by the annulus diameter ratio, Reynolds number, and the length to hydraulic diameter ratio. A correlation is developed which predicts 93% of the data used for its development to within ±10%. Dissert. Abstr.

N68-24044# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF NONEQUILIBRIUM FLOWS Final Summary Report, 1 Dec. 1964–1 Dec. 1967
J. W. Rich Jan. 1968 22 p refs
(Contract AF 49(638)-1488)
(AFOSR-68-0240; AD-667816)

The experimental part of the project concentrated on development and utilization of various spectroscopic techniques for monitoring vibrational state populations in high-temperature relaxing gas flows. The theoretical part of the project centered on master-equation analyses of various models for systems of vibrationally relaxing molecules. Abstracts of reports and papers published under the contract are included. The most recent experimental data, which have not as yet been published, are also given. Author (TAB)

N68-24113 Tennessee Univ., Knoxville.
AN EXPERIMENTAL STUDY OF CONSTITUTIVE EQUATIONS FOR VISCOELASTIC FLUIDS
Julian Orus Doughty (Ph.D. Thesis) 1966 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-1359

Four viscoelastic constitutive equations are examined for their ability to correlate linear dynamic data with non-linear viscosity and

first normal stress data. The theories examined are due to Oldroyd; Pao; Bogue; and Bernstein, Kearsley, and Zapas. The concepts and viscometric predictions of each theory are reviewed with more emphasis on the Pao theory due to a lack of discussion in the literature. A summary of classical linear theory is also presented. Experimental data were obtained on a Weissenberg Rheogoniometer for two materials: solutions of 10 percent polyisobutylene in Decalin and 12 percent polystyrene in Aroclor. A limited amount of data were also obtained for a 3 percent napalm solution. It was found that Oldroyd's three-constant theory and Pao's theory do not agree quantitatively with viscometric data. Bogue's theory and the Bernstein–Kearsley–Zapas theory do agree quantitatively with certain restrictions. Dissert. Abstr.

N68-24121 Missouri Univ., Columbia.
FORMATION OF ORGANIC DROPS FROM SUBMERGED NOZZLES
James Thomas Ryan (Ph.D. Thesis) 1966 181 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-933

The formation of discrete organic liquid drops in water from circular submerged nozzles was studied for a wide range of parameters using a correlation based on a simplified mathematical model. The method predicts drop frequency to within 7% using two empiric constants. The qualitative nature of gaseous bubble formation was also derived from the theory. Benzene, methyl isobutyl ketone, hexane, cyclohexanol and phenetole drops were studied. A theory of formation, based on a geometry-free model, was postulated to account for the effect of interfacial tension, fluid momentum, drop velocity and buoyancy. Analysis of the model indicates that dynamic drop formation may be divided into two regions. In the first region, the time lag between drop instability and complete detachment is a significant portion of the total formation time. The second region is dominated by the momentum of the fluid entering the drop. Calculations further showed that bubble formation is governed solely by the mechanism of the first region, the stuffing effect. Dissert. Abstr.

N68-24129*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RAREFIED-GAS COUETTE FLOW AND HEAT TRANSFER BETWEEN PARALLEL PLATES BY MODEL SAMPLING
Morris Perlmutter Washington May 1968 44 p refs
(NASA-TN-D-4579) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A rarefied gas with hard sphere molecules enclosed between parallel walls is analyzed for the case of couette flow and heat transfer by a model sampling procedure. In one case, both walls are stationary and at different temperatures. In the other case, the upper wall is moving in a direction parallel to the lower wall and both walls are at the same temperature. The wall accommodation factor is taken as unity. The target molecule velocity distribution is presumed to be the sum of two different half-Maxwellians. The parameters describing the half-Maxwellians are assumed constant over a given zone. By scoring the properties of sample molecules as they pass scoring positions, the macroscopic quantities, of interest are obtained. The problem is iterated until these values agree with the assumed distribution values. Author

N68-24143# Aeronautical Research Council (Gt. Brit.)
THE PERFORMANCE OF AN AIR–AIR EJECTOR ACCORDING TO A QUASI-ONE-DIMENSIONAL THEORY
W. T. Hanbury (Glasgow Univ.) Apr. 1967 62 p refs
(ARC-29341)

A quasi-one-dimensional theory is developed for the flow in an air-air ejector with sonic injection. It is based on the concept of 'general' or 'two stream' choking and deals with the constant area compressible mixing of two streams of the same gas with constant specific heats. Some numerical solutions are presented for the case of an air-air ejector. The effects of the total pressure ratio and total enthalpy ratio between the injected streams are also investigated. The theory is extended to cover the cases of supersonic injection and the mixing of two different gases. A few numerical results for supersonic injection are presented. Author (ESRO)

N68-24158# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
NOTES ON THE SOLUTION OF THE NAVIER–STOKES EQUATIONS FOR STEADY TWO-DIMENSIONAL TURBULENT FLOW BY FINITE-DIFFERENCE TECHNIQUES
D. B. Spalding Jun. 1967 62 p refs Sponsored by Northern Res. and Eng. Corp., Cambridge, Mass.
(SF/TN/5) CFSTI: HC $3.00/MF $0.65

The partial differential equations are assembled which govern the variations through a turbulent, compressible, swirling, steady fluid of: momentum, vorticity, stagnation enthalpy, mass concentration, turbulent kinetic energy, and stream function. From these equations are derived algebraic equations, connecting the values of the variables at a finite number of points arranged on a grid. A successive-substitution scheme is proposed which is known to be convergent in many circumstances and seems likely to be generally convergent. Tentative recommendations are made for the laws of turbulent exchange which should be adopted. The application of the method to several practically important circumstances is discussed in general terms. Author

N68-24223# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SENSITIVITY METHOD OF GLOW DISCHARGE FOR VISUALIZATION OF SUPERSONIC FLOWS OF RAREFIED GAS [VYSOKOCHUVSTVITEL'NYY SPOSOB TLEYUSHCHEGO RAZRYADA DLYA VIZUALIZATSII SVERKHZVUKOVYKH TECHNIY RAZREZHENNOGO GAZA]
V. M. Kalugin 7 Jul. 1967 16 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1966 p 108–112
(FTD-MT-24-125-67; AD-667848)

A new method of visualization of supersonic flows in wind tunnels is described. This method uses glow discharges in air and has all the advantages of discharge techniques and is, at the same time, very sensitive. The peculiarity of this method lies in the use of the nozzle as a cathode. A brief critical review of the existing methods where the model serves as a cathode is followed by a schematic diagram of the setup and a description of the experimental procedure. The advantages of this system and the mechanism of visualization are outlined. Author (TAB)

N68-24232 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXACT SOLUTIONS OF THE BOUNDARY LAYER EQUATIONS FOR PSEUDOPLASTIC FLUIDS ON A POROUS FLAT PLATE AND NEAR THE STAGNATION POINT [TOCHNYYE RESHENIYA URAVNENIY POGRANICHNOGO SLOYA PSEVDOPLASTICHNYKH ZHIDKOSTEY NA PRONITSAYEMOY PLOSKOY PLASTINE I VBLIZI]
B. Berkovskiy and Z. Shul'man 13 Oct. 1967 16 p refs Transl. into ENGLISH from the publ. "Voprosy Nestatsionarnogo Perenosa Tepla i Massy" Minsk, Nauka i Tekhnika, 1965 p 151–163
(FTD-HT-23-587-67; AD-667641)

The article considers the case of the boundary layer on a plate in a steady state homogeneous external stream. The equations of motion are given. Following substitution of new variables, the article presents exact solutions of these equations, as well as of the equations for the boundary layer in the vicinity of the critical point. Author (TAB)

N68-24283# Air Vehicle Corp., La Jolla, Calif.
LINEARIZED INVISCID-FLOW THEORY OF TWO DIMENSIONAL THIN JET PENETRATION INTO A STREAM
T. Strand and M. H. Y. Wei Feb. 1968 24 p refs
(Contract DA-31-124-ARO(D)-311)
(AROD-5274.4-E; Rept.-355; AD-667427)

The potential flow of a stream that interacts with a two-dimensional thin jet of a different total head, being injected into the stream from an infinite plane surface at an arbitrary angle, is analyzed using natural coordinates. The velocity magnitudes along the interface and the nondimensional shape of the interface between the jet and the stream are obtained as functions of the injection angle and the ratio of the free stream velocity to the velocity in the jet at infinity downstream. Results are presented for several cases when the jet issues at oblique angles from the surface, and also for the limiting case when the jet opposes the free stream. The latter case corresponds to the flow due to one branch of a translating two-dimensional jet after the jet has been split into two branches by impingement on the ground. It might also correspond to the flow of a two-dimensional thrust reverser. Author (TAB)

N68-24287# Centro Informazioni Studi Esperienze, Milan (Italy).
PHASE AND VELOCITY DISTRIBUTION IN TWO-PHASE ADIABATIC ANNULAR DISPERSED FLOW
P. Alia, L. Cravarolo, A. Hassid, and E. Pedrocchi Brussels EURATOM Mar. 1968 86 p refs
(Contract EURATOM-060-61-7 RDI)
(EURAEC-1091; EUR-3759.E) CFSTI: HC $3.00/MF $0.65

In the so-called annular-dispersed regime, the two-phase (gas + liquid) flow can be characterized by two main regions. In the first region (called "core"), located in the central part of the duct, the gas is the continuous phase while the liquid flows in the form of small droplets. In the second region, located close to the wall of the duct, the liquid is the continuous phase. Phase and velocity distribution in the core was determined by means of a probe which could operate either as a Pitot probe or as an isokinetic sampling probe. In the region close to the wall, the flow rates distribution was determined by means of a suitably-shaped isokinetic sampling probe. Thickness data of the "film region" have been also taken through an electrical method. The experiments were carried out at high pressure (up to ≈ 22 kg/cm^{2}abs.) and room temperature with argon-water and argon-ethyl alcohol mixtures in adiabatic vertical upward flow in circular tubes (1.5 and 2.5 cm I.D.). The measurements were performed in a position 3.5 m far from the mixing section. At this position, the flow was found to be fully (or almost fully, in the case of the highest flow rates) developed. Author

N68-24344*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
EULER–LAGRANGE RELATIONSHIP FOR RANDOM DISPERSIVE WAVES
D. P. Hoult 1 Apr. 1968 25 p refs Sponsored in part by MIT
(Grants NsG-134-61; NSF GK-554; Contract AF 49(638)-1708)
(NASA-CR-94679; SR-18) CFSTI: HC $3.00/MF $0.65 CSCL 20D

It is shown that the equations for the motion of a tagged fluid particle in a random wave field define a singular perturbation problem, characterized by a non-uniformity at large times. The uniformly valid asymptotic expansion to this problem, the Euler–Lagrange relationship for random dispersive waves, is obtained. As an application of these general results, an integral representation of the solution is worked out for the case of vertically propagating random acoustic waves in an isothermal atmosphere. It is shown that the non-uniformity of mediums leads to a wave generated diffusion process. The time and length scales over which the process is diffusive are determined, and a formula for the diffusion coefficient is presented. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-23087 Stanford Univ., Calif.
PALEOMAGNETISM OF THE PLIO-PLEISTOCENE LOUSETOWN FORMATION, VIRGINIA CITY, NEVADA
Donald Frederick Heinrichs (Ph.D. Thesis) 1966 58 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-4362

The natural remanent magnetization (NRM) of sixty-one lava flows from the Plio-Pleistocene Lousetown formation was measured. The field area extends from Virginia City, Nevada, to Truckee, California, on the eastern slope of the Sierra Nevada. The directions of remanent magnetization are used to analyze short-term variations of the recent paleomagnetic field and to assist in the stratigraphic interpretation of the Lousetown formation. The flow mean directions separate into two distinct groups. Both sets of flows have directions of magnetization that are significantly different from an axial dipole field. It is concluded from the respective directions of magnetization that: (1) the first set of flows represents an intermediate direction of the geomagnetic field during a transition from reverse to normal polarity, and (2) the field deviated significantly from an axial dipole field during the late Pliocene. Dissert. Abstr.

N68-23093# Lincln Labs., Mass. Inst. of Tech., Lexington.
A STUDY OF TWO SHORT PERIOD DISCRIMINANTS
Edward J. Kelly 12 Feb. 1968 60 p refs
(Contract AF 19(628)-5167; ARPA Order 512)
(TN-1968-8; ESD-TR-68-16; AD-666701)

The paper is the result of a large-population study of discrimination between earthquakes and explosions, using only short-period data from a single station. The data was obtained from the Large Aperture Seismic Array and the two discriminants studied were waveform complexity and spectral ratio. Procedures for multivariate discrimination are developed and results are given in terms of earthquake identification percentages using these discriminants singly, and in combination with each other and with magnitude. The results are quite encouraging, complete separation being found for explosions and shallow earthquakes using spectral ratio and magnitude together. Author (TAB)

N68-23097# Stanford Univ., Calif. Radioscience Lab.
A STUDY OF THE MECHANISMS OF WHISTLER PROPAGATION AND VLF EMISSION GENERATION Final Report, 1 Oct. 1966–30 Sep. 1967
Robert A. Helliwell Jan. 1968 14 p refs
(Grant AF-AFOSR-783-67)
(AFOSR-68-0219; AD-666648)

Extensions to the theory of vlf propagation in the magnetosphere with the effects of ions included have explained dispersion characteristics of magnetospherically-reflected (MR) whistlers, a complex phenomenon discovered recently with satellites. Because its dispersion depends on both electron and ion distributions, as well as on the static magnetic field, the MR whistler may be useful as a new tool in the study of the magnetosphere. It was found that the sharp cutoff of ducted whistlers at half the minimum gyrofrequency on the path is often accompanied by whistler amplification and generation of discrete vlf emissions near the cutoff frequency. Satellite data show that ducts are not required for the generation of discrete vlf emissions and that the region of generation most likely lies near the top of the line of force thru the satellite. Observations of artificially-stimulated emission on the

ground show that their occurrence peaks up when the minimum gyrofrequency is twice the triggering frequency. A new theory was advanced to explain the generation of discrete vlf emissions and is based on cyclotron resonance between electrons in the kev energy range and a longitudinally propagating wave. TAB

N68-23186# Aeronautical Chart and Information Center, St. Louis, Mo. Chart Research Div.

A MAGNETIC MAP OF THE BRAZILIAN ANOMALY [MAGNITNAYA KARTA BRAZIL'SKOY ANOMALII]

L. V. Konovalova and V. I. Nalivayko Nov. 1967 10 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 7, no. 2, 1967 p 394–395

(ACIC-TC-1286; AD-665200)

Satellites Cosmos 49 and Cosmos 26 conducted measurements of the magnetic field by means of the proton magneto-meters according to the program of the world magnetic survey. The area of the Brazilian magnetic anomaly was covered by a dense network of measurements which were used in the construction of the magnetic map of anomalies. The necessity to compile such a map was induced by the interest of the anomaly in connection with isolation of an area of increased intensity radiation near the Brazilian shoreline. Study of this radiation is of interest for the theory of radio-active belts. This paper is a study of the compilations used to assemble this map. Author (TAB)

N68-23210*# Geological Survey, Denver, Colo.

EVALUATION OF RADAR AND INFRARED IMAGERY OF SEDIMENTARY ROCK TERRANE, SOUTH-CENTRAL YELLOWSTONE NATIONAL PARK, WYOMING

William R. Keefer May 1968 14 p

(NASA Order R-09-020-015)

(NASA-CR-94544; NASA-106) CFSTI: $3.00 CSCL 08G

Side-looking radar imagery (K-band) and night-time infrared imagery (3-5μ band) were compared over the same sedimentary terrain of south-central Yellowstone National Park to determine if either type of imagery could be used in differentiating rock types and delineating structural features. Although sedimentary rocks of greatly contrasting composition occur in the area, none had detectable tonal characteristics on either types of imagery. This is believed to be due, in part, to masking by vegetation. Flay lying volcanic rocks having smooth topographic profile were readily detectable on both radar and IR imagery. Quaternary surficial deposits were easily detected in IR imagery. Numerous faults of large displacement were not detected by either form of imagery except where the faults were expressed by topography. Author

N68-23217 Stanford Univ., Calif.

REMANENT MAGNETIZATION OF THE LATE YAKIMA BASALT, WASHINGTON STATE

Jan David Rietman (Ph.D. Thesis) 1966 114 p

Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-4422

Oriented cores from the Late Yakima Basalts were studied to establish the origin and magnitude of intraflow variations in the direction of remanent magnetization and to develop the use of remanent magnetization as a flow-by-flow stratigraphic correlation method. The direction of thermoremanent magnetization provides a unique characteristic which can be used to identify individual members and, in some instances, individual flows throughout the entire lateral extent of these basalts. An analysis of the measured directions, after demagnetization, indicates that angular differences as small as 10 degrees between the mean directions in two flows can be recognized over distances in excess of 200 miles. Anomalous intraflow directions were related to mineralogical alteration, ancient geomagnetic field anomalies, and to variations in tectonic history. The Late Yakima Basalts were extruded during a transition of the geomagnetic field from normal (parallel to the present field) to reversed and back to normal. Dissert. Abstr.

N68-23221# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

STRUCTURE OF THE EARTH'S CRUST IN THE ARCTIC [STROYENIYE ZEMNOY KORY V ARKTIKE]

R. M. Demenitskaya et al. Feb. 1968 15 p refs Transl. into ENGLISH from "International Geological Congress, Session 22, 1964. Reports of Soviet Geologists, Problem 16, Geology of the Ocean and Sea Bottoms" Moscow, Nauka Publisher, 1964 p 114–121

(ACIC-TC-1283; AD-667078)

This translation is a study of the crustal structure in the Arctic, based on seismic, aeromagnetic and bathymetric observations in recent years. Seismic evidence indicates an extensive development of a two layered structure of sedimentary complex and an abrupt change of the thickness of deposits in the Arctic basin. This suggests recent intensive tectonic movements. A new map of submarine ridge axis is presented, showing the position of a new ridge and other possible rises of the Arctic Ocean floor. A map of crustal thickness in the Arctic is presented. The earths crust in the Arctic is predominantly oceanic and intermediate and is characterized by considerable change of thickness. Great variation in crustal thickness and that of a sedimentary complex, irregular bottom topography, recently discovered and supposed rises on the ocean floor, different physical fields -- all this suggests a distinctive block structure of the earths crust in the Arctic. Author (TAB)

N68-23225# Utah Univ., Salt Lake City. Upper Air Research Lab.

ROCKET AND SATELLITE TECHNIQUES FOR MEASUREMENT OF ELECTRON DENSITY AND RELATED IONOSPHERIC PARAMETERS Final Report, 1 Apr. 1965–31 Mar. 1967

David A. Burt, Glenn D. Allred, and Clay D. Westlund Dec. 1967 95 p refs Sponsored in part by DASA

(Contract AF 19(628)-5044)

(UU-67-9; AFCRL-68-0010; AD-666671)

Normal concentrations of electron density in the earths ionosphere and changes in these concentrations associated with various disturbances, both natural and man made, have been investigated by a series of eight rocket and satellite payloads. Instruments for measuring fine scale, long term deviations and short term, larger scale deviations in electron density and other related parameters have been included in each payload. This report details instrumentation and presents brief results of the experiments developed by Upper Air Research Laboratory, University of Utah, for each of the following programs: Aerobee 150 (3.614) D-region, gyro-interaction; Four Nike-Hydacs solar eclipse (12 November 1966); OV2-3 Satellite electron density at sychronous orbit altitude; OV3-2 Satellite F-region electron density (polar orbit); Javelin (19.191) F-region irregularities - pulse-phase delay experiment. Author (TAB)

N68-23248# General Dynamics/Convair, San Diego, Calif.

MEASUREMENT OF CLOUD REFLECTANCE PROPERTIES AND THE ATMOSPHERIC ATTENUATION OF SOLAR AND INFRARED ENERGY Final Report, Sep. 1965–Dec. 1967

M. Griggs and W. A. Marggraf Dec. 1967 165 p refs

(Contract AF 19(628)-5517)

(AFCRL-68-0003; AD-666936)

The results of measurements made with an instrumented DC-3 aircraft are presented and discussed. In the infrared 8 to 14 microns window region, both the integrated and spectral radiances

of different surfaces were measured as a function of altitude to 18,000 feet, and compared with a theoretical model. Surface temperature measurements were made in order to determine the mean emissivity of stratus clouds, the ocean, the desert, and snow, in the window region. In the visible region, the albedos of the above surfaces, plus forest and grass surfaces, were determined from measurements of the total down and total up fluxes of solar radiation. The total down flux measurements are compared with a theoretical model. The directional reflectivity and polarization of stratus clouds, the ocean, and snow, were determined as a function of wavelength in the visible region. These optical properties of clouds are related to cloud properties such as thickness, liquid water content, and droplet size distribution. Stratus cloud radiances determined with an aerial camera on a U2 at altitudes up to 65,000 feet are analyzed. Author (TAB)

N68-23260# Illinois Univ., Urbana. Illinois State Water Survey.
PROGRAM IN ATMOSPHERIC ELECTRICITY AND CLOUD MODIFICATION FLAGSTAFF-1966 Final Report
D. M. A. Jones, ed. Feb. 1968 117 p refs
(Contract DA-28-043-AMC-02376(E))
(ECOM-02376-F; AD-666795)

The report summarizes the data collection and preliminary analyses of various activities under Army support which were carried out in the Flagstaff area in the summer of 1966. A number of investigators have provided reports of their activities which have been combined into one volume. Basic studies were undertaken to study the raindrop-size distribution, radar echo climatology, and chloride particle concentrations by the Water Survey. Infra-red measurements, electrical measurements of clouds, and chaff seeding were carried on by the Army. The results of the field program provided additional information concerning meteorological conditions pertinent to precipitation of the Flagstaff area as well as additional support that chaff seeding influences the electrical fields of growing cumulus clouds. The resulting drop-size measurements suggested a different distribution of raindrops on several days which are either due to silver iodide seeding by another group in the area or from the evaporation of the falling drops. Author (TAB)

N68-23261# Utah Univ., Salt Lake City. Upper Air Research Lab.
INSTRUMENTATION FOR AIR DENSITY MEASUREMENTS Final Report, 1 Jun. 1964–31 May 1967
Clay D. Westlund, Obed C. Haycock, Russell L. Smith, and Glenn D. Allred Sep. 1967 82 p refs Sponsored in part by DASA
(Contract AF 19(628)-4055)
(UU-67-6; AFCRL-67-0532; AD-666649)

This report details an operational system for measuring air density at altitudes above those investigated by instrumented balloons and below those investigated by orbiting satellites. The system described is a 7-inch, rigid, falling sphere which is ejected from a rocket and falls through the atmosphere. Measurements directly related to air density are obtained by using a transit time accelerometer and related electronics incorporated within the sphere. The system has been used for a total of twenty-eight flights during this reporting period and has provided air density measurements between 20 and 120 km. Author (TAB)

N68-23268# United States Lake Survey, Detroit, Mich.
GREAT LAKES ICE COVER, WINTER 1966–1967 Final Report
Donald R. Rondy Nov. 1967 71 p
(BD-5-3; AD-666223)

The report describes the U. S. Lake Surveys 1966-67 aerial ice reconnaissance program and presents 40 ice charts produced from data collected on 18 flights. A brief description of ice conditions on each of the Great Lakes and a summary of weather conditions is included. Author (TAB)

N68-23281# Boston Coll., Chestnut Hill, Mass.
RESEARCH DIRECTED TOWARD THE COLLECTION, REDUCTION AND EVALUATION OF GEOMAGNETIC FIELD DATA Final Report, 1 Nov. 1964–31 Oct. 1967
John F. Devane and John E. Hogan 5 Jan. 1968 48 p refs
(Contract AF 19(628)-4793)
(AFCRL-68-0014; AD-666935)

The operation of the Weston Geomagnetic Observatory is described. Brief descriptions are given of the Weston Index of magnetic activity, and of projects on the quiet day variation, telluric current and micropulsation recording. The support of the Air Force program of geomagnetic field measurement by rockets is described. This includes a detailed description of the process whereby taped data from rocket flights is processed. Results of theoretical investigations of geomagnetic field phenomena are cited through resulting publications. Author (TAB)

N68-23286# Environmental Research Corp., Alexandria, Va.
MAGNIFICATION OF LOVE WAVES
Abraham Schultz 13 Oct. 1967 28 p refs
(Contract AT(29-2)-1163)
(NVO-1163-80) CFSTI: HC$3.00/MF$0.65

Consistent variations in seismic signal strength, resulting from NTS events, along the southeast line to Las Vegas have been oseerved for some time. It has been assumed that these variations were somehow connected with the changes in thickness of the alluvial layer. An attempt to give a quantitative explanation of these variations resulted in the development of a general theory of Love-wave magnification. Given that two stations both record a Love-wave, this theory enables one to relate the relative signal strength between the two stations to the layering structure beneath the stations. Reasons are given for assuming that the low frequency transverse component is a Love-wave. Comparisons are made between experimental and theoretical values of magnification for the events Cup, Kestrel and Wagtail at stations SE-3, SE-4, SE-5 and SE-6. Because the elastic constants and layered thicknesses which are used as input to the mathematical model are not accurately known, it is difficult to evaluate the utility of this model with regard to the prediction problem. Acquisition of physical properties measurements is planned for further studies on the general question of magnification of surface motions. Author (NSA)

N68-23291# Environmental Science Services Administration, Boulder, Colo. Research Labs.
BEHAVIOR OF A HIGH LATITUDE HYDROMAGNETIC WAVE PHENOMENON OBSERVED AT CONJUGATE LOCATIONS
W. H. Campbell Dec. 1967 14 p refs
(RLTM-ESL-6; AD-666953)

The study is a summary of the characteristics of the pc 1 geomagnetic field pulsation phenomenon in the 0.15 to 3.5 c/s frequency range with emphasis on the behavior at auroral latitudes. That the detected emissions are manifestations of resonant hydromagnetic wave propagation on the earths field lines is evidenced by the preferred simultaneous occurrence at conjugate field locations. The occurrence times of high latitude emissions indicate that the excitation is on the sun side of the magnetosphere. The resonance frequency changes uniformly with local time. There seems to be coupling to other than field-guided propagation modes when the waves reach ionospheric altitudes. Large auroral associated absorption appreciably attenuates the signals. Present problems in understanding the pc 1 phenomenon are discussed. Author (TAB)

N68-23305# California Univ., Livermore. Lawrence Radiation Lab.
UPPER LIMIT OF ELECTRON LOSSES DURING E LAYER BUILDUP
N. C. Christofilos 24 Jan. 1968 17 p refs
(Contract W-7405-ENG-48)
(UCID-15265) CFSTI: HC $3.00/MF $0.65

The interaction of newly injected electron pulses with the electrons previously trapped in the E layer is examined, and the upper limit of loss of trapped electrons caused by this interaction is calculated. NSA

N68-23331# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OXYGEN ABSORPTION IN THE BAND FROM 53.4 TO 56.4 GHZ, DECEMBER 1964–OCTOBER 1967
C. J. Carter, R. L. Mitchell, and E. E. Reber Oct. 1967 61 p refs
(Contract F04695-67-C-0158)
(TR-0158(3110-01)-2; SAMSO-TR-68-103; AD-666916)

The report summarizes the findings of an extensive study (December 1964 through June 1967) of the phenomenon of absorption of electromagnetic energy in the atmosphere by oxygen. Purpose of the study was to make sufficient measurements in the oxygen absorption spectrum (50 to 70 GHz) to confirm or refine the existing theory as necessary. New values for the Van Vleck line broadening coefficients have been calculated, based on 1500 independent attenuation measurements made over a slant range from space to various altitudes in the atmosphere, on a frequency range of 53.4 to 56.4 GHz and an altitude range from 0 to 45,000 ft (14.75 km). The average relative error between the measured and the calculated attenuation is 8.6 percent. A similar comparison based on Meeks and Lilleys line broadening coefficients yielded an average relative error of 13 percent. Author (TAB)

N68-23375# Gulf South Research Inst., New Iberia, La. Environmental Sciences and Engineering Labs.
HYDROGRAPHIC STUDIES IN THE NORTHEAST GULF OF MEXICO
Kirby L. Drennan Jan. 1968 121 p refs *Its* Ref. 68-0-1
(Contract N00014-67-C-0514)
(AD-666629)

The major circulatory features and distribution of physical properties in the northeast Gulf of Mexico are presented from a series of eight quasi-synoptic surveys. Seasonal changes in hydrography and circulation over the continental shelf are shown and discussed in terms of their relationship to the offshore currents, river discharge, winds, and tides. Surface current speed and direction are determined from an extensive drift bottle study and distribution of density. Author (TAB)

N68-23406*# Geological Survey, Denver, Colo.
GEOLOGICAL INTERPRETATION OF INFRARED IMAGERY OF THE PEND OREILLE AREA, IDAHO
Jack E. Harrison May 1968 13 p refs
(NASA Order R-09-020-015)
(NASA-CR-94543; NASA-72) CFSTI: $3.00 CSCL 08G

Infrared imagery covering an area about 7 miles wide and 36 miles long in the Lake Pend Oreille area, Idaho was collected on August 8, 1966. The image was recorded between 2151 and 2202 MDT, about 1-1/2 hours after sunset on the highest peaks, and was collected using a Reconofax IV instrument with no filter. The imagery has been compared with (1) geologic maps, (2) vertical aerial black and white photographs taken in 1946, and (3) oblique black and white aerial photographs of part of the area taken on September 4, 1933. Author

N68-23436*# Massachusetts Inst. of Tech., Cambridge.
CORRECTION OF BALLOON X-RAY ASTRONOMY DATA FOR THE EFFECTS OF ATMOSPHERIC ATTENUATION, K X-RAY ESCAPE, AND ENERGY RESOLUTION
James W. Overbeck Washington NASA May 1968 30 p refs
(Grant NsG-386)
(NASA-CR-1045) CFSTI: HC $3.00/MF $0.65 CSCL 04A

An X-ray flux from outside the atmosphere determines the counting rate of an X-ray detector beneath several g/cm^2 of atmosphere, but a unique inverse relationship does not exist. Therefore X-ray astronomy data analysis requires the computer simulation of the processes which transform assumed X-ray energy spectra into detectors' counting rates. The programs used by the author, E. Allen Womack, Jr., and Harvey D. Tananbaum are presented and are applied to a specific example. A set of conventions for presenting one's results as an X-ray spectrum above the atmosphere is also explained. Author

N68-23510 New Hampshire Univ., Durham.
MEASUREMENTS OF IONOSPHERIC CURRENTS
Nelson Charles Maynard (Ph.D. Thesis) 1966 171 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-164

Eight Nike-Apache sounding rockets were instrumented to investigate the vertical current distribution of the equatorial electrojet over India and off the coast of Peru, to investigate the vertical current distributions of the S_q current system at low latitudes off the coast of Peru, to determine if the lunar current system is separate from, or part of, the S_q system, and to correlate these measurements with simultaneous electron density measurements. Dissert. Abstr.

N68-23527*# General Electric Co., Philadelphia, Pa.
EXPERIMENT S048: 2 VISIBLE RADIATION POLARIZATION MEASUREMENTS, PHASE C Final Report, 7 Sep. 1967–5 Jan. 1968
R. T. Frost Jan. 1968 156 p refs Prepared jointly with Calif. Univ.
(Contract NAS9-7267)
(NASA-CR-65952) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The results of a phase study are summarized, with the purpose of defining the experiment preliminary design, specifications, management plans for the flight hardware phase of the program, and providing a mockup of the experiment. The objective of the experiment is to make quantitative measurements of intensity and polarization of the light emerging from the top of the earth's atmosphere as a function of wavelength, and to relate these to a theoretical treatment of radiation transfer in the earth's atmosphere. The preliminary design of the equipment necessary to carry out the experiment is given, with emphasis on the mechanical optical, and electrical design of the photopolarimeter. A system analysis is presented on the three main subsystems which are the photopolarimeter instrument, the mechanical scan platform, and the in-flight calibrator unit. As a part of the test verification of the preliminary design, a breadboard model was assembled to demonstrate the performance of the instrument and scan function generator. System and subsystem requirements of the ground support equipment are delineated, and the testing of the breadboard model of the photopolarimeter is described. B.S.D.

N68-23547*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Quarterly Status Report, 1 Jan.–1 Apr. 1968

Walter E. Lewis 1 Apr. 1968 40 p refs
(NASA Order R-09-040-001)
(NASA-CR-94590) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Summary data are presented on the 18 research projects being conducted to develop mineral resource technology for supporting manned lunar and planetary missions. The information reported covers the thermal and electrical properties of simulated lunar rocks in an earth environment; the effect of reactants ratio on the carbothermal reduction of silica; experimental results for the carbothermic reduction of silicates; and the classification of silicates by structural arrangements, general formula, mineral group, and the igneous rock group containing the silicate. M.G.J.

N68-23571*# Alaska Univ., College. Geophysical Inst.
RADIOWAVE SCATTERING STRUCTURE IN THE DISTURBED AURORAL IONOSPHERE: SOME MEASURED PROPERTIES, VOLUME 1
Edward J. Fremouw Jun. 1966 167 p
(Contract NAS5-3940; Grant NSF GP-947)
(NASA-CR-94552; UAG-R-180, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Multi-spaced interferometric measurements of a radio star are used to describe the radio wave scattering structure in a disturbed auroral ionosphere. Output voltage decreases are correlated to scattering by random noise theory and the statistical characteristics of amplitude, phase, and complex signal for a general arbitrary degree of scatter are developed. Application of this theory to observations with phase switch and phase sweep interferometers yields the received wavefront, the coherance radio, and the wavefront autocorrelation function which in turn are used to determine the optical depth and the ion-density irregularities in the ionospheric scattering region. Analyses of 49 visible fades reveal an approximately inverse-square dependence of the optical depth on radio frequency phase deviations. It is concluded that the disturbed auroral ionosphere displays evidence of quasi-periodic structure in the dimensional range of tens and hundreds of meters. Narrow beam photometer recordings of auroral luminosity during 100% visibility fades at night indicate that radio star visibility fades in the auroral zone result from scattering by irregularities directly associated with auroral forms. G.G.

N68-23578# Aeronautical Chart and Information Center, St. Louis, Mo.
BASIC FEATURES OF TECTONIC STRUCTURE OF THE BOTTOM OF THE MEDITERRANEAN SEA [OSNOVNYYE CHERTY TEKTONICHESKOGO STROVENIYA DNA SREDIZEMNOGO MORYA]
Ye. M. Yemel'yanov et al Jan. 1968 30 p refs Transl. into ENGLISH from the publ. "Geologiya Dna Okeanov i Morey" Moscow, Nauka Press, 1964 p 97–113
(ACIC-TC-1284; AD-667077)

New tectonic and bathymetric charts of the Mediterranean Sea, some results of seismic investigations, tectonic charts of Europe and Eurasia, data on volcanism, earthquakes and gravimetry are used in this paper. The different geological history is clearly expressed in the bottom topography of the Western and Eastern basins of the Mediterranean Sea. Accumulative plains occupy large areas in the Algiers-Provence and Tyrrhenian basins. Abyssal areas and two systems of deep-sea depressions are found. The thickness of the sediments vary between the eastern and western part of the Mediterranean Sea. There is no granitic layer in the deep sea parts of certain sections. The Mediterranean Sea is considered as a basin of transition type of the earths crust. Side by side with the stabilized areas there are also some areas of uncompleted Alpine cycle with signs of transformation of the continental crust into the oceanic type. Author (TAB)

N68-23597*# Stanford Univ., Calif. Radioscience Lab.
DETERMINATION OF RATES OF PRODUCTION AND LOSS OF ELECTRONS IN THE F REGION OF THE IONOSPHERE FROM OBSERVATIONS OF GEOSTATIONARY SATELLITE TRANSMISSIONS
Fred L. Smith, III Mar. 1968 137 p refs
(Grant NsG-30-60)
(NASA-CR-94604; SEL-67-102; TR-10) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Accurate measurements of the amount of Faraday rotation imposed on VHF telemetry transmissions from a geostationary satellite have been analyzed to study rates of production and loss of electrons in the F region of the ionosphere. The rate of photoionization of atomic oxygen, integrated with respect to height through the ionosphere was determined at sunrise over Hawaii. The analysis also yielded the magnitude of the linear loss coefficient at an altitude of 300 km. The integrated rate of production of O^+ ions at sunrise was used to deduce the total flux of solar radiation in the 165 to 911 Å wavelength range incident on the earth's atmosphere. Atomic oxygen photoionization rates and solar EUV flux values were obtained on a daily basis, and loss coefficients on a monthly average basis, over the 2-year period extending from September 1964 through August 1966. Author

N68-23618# International Geophysical Year World Data Center A, Washington, D. C.
GRAVITY, TSUNAMI, SEISMOLOGY, LONGITUDE AND LATITUDE, METEOROLOGY Catalogue of Data
Mar. 1968 57 p

Based on the international exchange of geophysical observations, tabulations are presented on gravity, tsunami, and seismology data. The two IGY longitude and latitude projects—the transit instrument and astrolabe observations, and the moon-position camera observations—are reviewed. Meteorological data, cataloged by region, country, station, and period of record, are listed for such projects as solar radiation, ozone, atmospherics, atmospheric chemistry, atmospheric electricity, geotemperature, and nuclear radiation. M.G.J.

N68-23625 Arizona Univ., Tucson.
A SPECTRAL STUDY OF LIGHTNING STROKES
Richard Edmonds Orville (Ph.D. Thesis) 1966 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-147

A ten meter section of the lightning return stroke has been isolated, and the spectral emissions recorded from 4000 A to 6600 A. The time resolution is 5 μsec. All emissions have been attributed to neutral or singly ionized atoms of nitrogen and oxygen. All spectra have been recorded on film calibrated with a xenon source of known relative spectral emittance. A high speed spectroscopic study was also made of a long spark in air. Integrated spectra obtained with a slitless spectrograph indicate the emissions from the long spark are very similar to the emissions from lightning in the 4000 A to 8900 A region. Time resolved spark spectra were obtained with 2 μsec resolution. Temperature, electron density, percent ionization, and pressure have been calculated as a function of time for the first 14 μsec. Dissert. Abstr.

N68-23679# Massachusetts Inst. of Tech., Cambridge.
OCEANOGRAPHIC RESEARCH AT M.I.T. IN THE DEPARTMENT OF GEOLOGY AND GEOPHYSICS AND THE DEPARTMENT OF METEOROLOGY Progress Report, 1 Jan.–31 Dec. 1967
Shawn Biehler, Dayton E. Carritt, Delbar P. Keily, H. Thomas Rossby, M. Gene Simmons et al Feb. 1968 129 p refs

(Contract Nonr-1841(74))
(PR-6; AD-667605)

The progress report covers research in oceanography at M.I.T. by several professors and students under the sponsorship of the Office of Naval Research in the following areas: Heat flow; gravity; magnetics; seismic; magnitude of gravity; vibrating string accelerometer; atmospheric chemistry; sea-air interaction; marine aerosols; trace gaseous constituents; oceanic particulates; light scattering; ocean currents; horizontal velocity; inertial system; ocean currents; neutrally buoyant floats; permanent sound channel; internal waves. Author (TAB)

N68-23695*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIRECT, IN SITU MEASUREMENTS OF WAVE PROPAGATION IN THE NEUTRAL THERMOSPHERE
George P. Newton, David T. Pelz, and Hans Volland (NAS-NRC) Feb. 1968 32 p refs
(NASA-TM-X-63198; X-621-68-44) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The density gauges on the Explorer 32 satellite have measured local variations in the atmospheric density which confirm that waves propagate in the neutral atmosphere. The waves were observed in the Northern Hemisphere over the altitude range from 286 km (satellite perigee) to at least 510 km. The waves are most prevalent at the higher latitudes near the auroral zone (orbit inclination is 65°) and were observed most frequently in the late evening and early morning hours, but were not limited to these latitudes and times. The virtual vertical half-wavelengths of the waves increase with altitude from 1 km at 286 km altitude to 70 km at 510 km altitude. Four integrally related wavelengths have been observed, a "fundamental" and the second, third, and fourth harmonics. The wave half-amplitudes range from the limit of detectability to the largest observed to 50% of the smoothed density profile value. These waves are identified as free internal gravity waves propagating predominately north–south, or south–north, with horizontal wavelengths between 130 and 520 km and periods between 10 and 100 min. This interpretation is consistent with observations of large scale traveling ionospheric disturbances by Thome and Georges. Author

N68-23698# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
QUARTERLY RADIO NOISE DATA, MARCH, APRIL, MAY 1966
W. Q. Crichlow, R. T. Disney, and M. A. Jenkins Jun. 1967 51 p refs
(IER-18; ITSA-18-30) CFSTI: $3.00

A number of radio noise recording stations are operated in a program coordinated by the Environmental Science Services Administration. Measurement results are given as month-hour and time block median and decile values. The parameters recorded are the noise power expressed in terms of an effective antenna noise factor, f_a, and the mean voltage and mean logarithm expressed as deviations, V_d, and L_d, in dB below the average power. The data should be used, realizing the values given may reflect levels of atmospheric noise, man-made noise, or station interference. Author

N68-23699# Stanford Univ., Calif. Radioscience Lab.
SOME RELATIONSHIPS BETWEEN AURORA AND NATURAL VLF AND LF NOISE AT PLATEAU STATION, ANTARCTICA
Robert B. Flint, Jr. Feb. 1968 54 p refs
(Grants NSF GA-214; NSF GA-1151)
(SU-SEL-68-016; SR-1)

This investigation is carried out in two parts: diurnal variations in occurrence are found for aurora and noise, and a minute-by-minute examination of relationships is made for a one-week period. Diurnal occurrence of noise at 110 kHz peaks before magnetic midnight at about the same time as a peak occurs in the more familiar diurnal curves of occurrence of noise at 8 kHz and of aurora. Examples are shown of several events in which associations between variations in noise and variations in auroral elevation, intensity, form, and rate of change can be found from detailed comparison of the data. Bursts of noise occasionally appear on the 110 kHz channel in the absence of noise on the other channels. Over the week as a whole, the average noise level correlates positively with auroral intensity at each of the noise frequencies. The average noise level is less following the main magnetic bay each night than before it. The majority of all noise changes during the week is found to coincide with changes in the aurora. Author

N68-23706*# North American Aviation, Inc., Downey, Calif.
EARTHQUAKE PREDICTION FROM LASER SURVEYING
R. A. Fowler Washington NASA 1968 37 p refs Prepared for NASA
(NASA-SP-5042) GPO: HC $0.35 CFSTI: MF $0.65 CSCL 08K

A geodetic laser survey system is described that overcomes the uncertainty introduced by atmospheric fluctuations affecting the refractive index value; and the resultant variations in the velocity of the electromagnetic waves that ordinarily cause distortions in distance measurements are considered. Applications of such systems to earthquake prediction and engineering research, geodetic problems, dam construction, and space research are described. Probability maps and laser survey technology development are discussed in relation to earthquake prediction; and passive versus active systems as well as the limitations of existing systems are considered for precise measuring of long distances. The theory for atmospheric refractive index corrections using dispersion techniques is considered, along with the mathematical models required for making the necessary calculations. M.W.R.

N68-23760# American Meteorological Society, Boston, Mass.
THE ZONAL DISTRIBUTION OF RADIATION REFLECTED FROM VARIOUS NATURAL SURFACES [ZONAL'NOE RASPREDELENIE RADIATSII, OTRAZHENNOI RAZLICHNYMI ESTESTVENNYMI POVERKHNOSTIAMI]
N. I. Goisa and M. P. Fedorova Bedford, Mass. AFCRL Jan. 1968 13 p refs Transl. into ENGLISH from Ukr. Nauchn.-Issled. Gidrometeorol. Inst., Tr. (Kiev), no. 48, 1965 p 113–120
(Contract AF 19(628)-3880)
(T-R-566; AD-667414)

Data are presented on the zonal distribution of radiation reflected by a field of barley in the ear formation stage, a field of barley in the stage of waxy maturity, barley stubble, Sudan grass, dry snow, snow covered with an ice crust, and stratus cloud cover. Author (TAB)

N68-23772# General Atronics Corp., Philadelphia, Pa.
LARGE APERTURE SEISMIC ARRAYS (LASA)
Bedford, Mass. AFSC, Electron. Systems Div. Mar. 1968 86 p refs
(Contract AF 19(628)-67-C-0370; ARPA Order 800)
(QTR-3; ESD-TR-68-148; AD-667794)

Four topics are discussed in this report. The first topic is the detection of underground nuclear explosions in the presence of large natural events. Previous studies of this problem have been extended and partially confirmed by applying calculations to additional data and by considering the effect of strengthening certain assumptions. The use of a LASA for estimating epicenters by beamforming and other methods is the second topic considered in this report. Recent studies of this topic have employed computer-aided simulations with controlled amounts of additive noise and travel-time

anomalies to examine the relative performance of different algorithms for epicenter estimation. The third topic considered in this report is an analysis of detection and false alarm probabilities for a DIMUS array. Taking advantage of a strong analogy between this problem and a standard problem in coding theory, bounds and asymptotic expressions for these probabilities are described, and the signal-to-noise ratio loss of the DIMUS array over the corresponding analog array is analyzed as a function of several parameters. Finally, the previously developed automatic pP test has been re-examined with a view toward evaluating its performance and simplifying its implementation. Author (TAB)

N68-23793# National Center for Atmospheric Research, Boulder, Colo.
NCAR RESEARCH AND FACILITIES PROGRAMS Annual Report, 1967
Apr. 1968 205 p refs

Coronal structure and motion studies are described, along with attempts to combine proper models of the lower solar atmosphere with the theories of radiative transfer to reproduce observed solar activity effects. Circulation problems in the earth's upper atmosphere are discussed in terms of extended range predictions and the causes of climatic change. Research in the areas of atmospheric chemistry and microphysical effects that govern precipitation is reported. The support of postdoctoral fellows and senior scientists at the High Altitude Observatory is described, and a list of advanced study program publications is included. The research laboratories and equipment available are described for the Scientific Balloon Facility, the Research Aviation Facility, the Field Observing Facility, and the Global Atmospheric Measurements Program. E.J.S.

N68-23815# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CHANGE IN pH OF AQUEOUS EXTRACT OF ROCKS IN THE ZONE OF DISJUNCTIVE DISLOCATIONS [OB IZMENENII pH VODNOY VYTYAZHKI GORNYKH POROD V ZONE DIZ'YUNKTIVNYKH NARUSHENIY]
A. F. Gorovoy *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 1–5 refs (See N68-23814 13-15)

A report based on experiments with core mining samples of various composition taken from a site of known disjunctive dislocations proves that, in general, the pH of aqueous extracts of the samples will increase proportionately with the depth from which the sample was recovered, except that samples from areas of disjunctive dislocation will have generally decreased pH values. Determination of pH values was made by electric and calorimetric analysis of aqueous extracts of each component of the boring sample. Results also showed that each type of rock has a specific ph value. Causes for findings of pH values not proportionate to depth are attributed to the proximity of atmospheric material, and the granulometric composition of the rock. Failure of pH reading progress according to depth is considered to be an indication of an underground zone of dislocation. The extent of which can thus be measured. Author

N68-23867*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
MIDLATITUDE NEUTRAL THERMOSPHERE DENSITY AND TEMPERATURE MEASUREMENTS
David T. Pelz and George P. Newton Dec. 1967 25 p refs
(NASA-TM-X-63196; X-621-67-609) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Six independent aeronomy experiments were launched. Two Bayard–Alpert ionization gauges were flown to measure neutral atmospheric density and temperature. However, the Bayard–Alpert gauges appear to have pumped or absorbed virtually all of the atmospheric atomic oxygen (O) to which they were exposed, and thus measured only the molecular nitrogen (N_2), molecular oxygen (O_2), and helium (He), in the region from 150 km to 450 km altitude. Deduced N_2 number densities (1.9×10^{10}, 3.5×10^{7}, and 1.9×10^{5} particles cm^{-3} at 150 km, 300 km, and 450 km respectively) agree with nearly simultaneous measurements obtained from a neutral mass spectrometer and a solar EUV extinction experiment. Previous N_2 measurements from Thermosphere Probes, obtained under similar solar and geomagnetic conditions, agree well with these data. An exospheric temperature near 875°K was determined for the 1300 hour local solar time atmosphere. The O pumping, presumably by initially oxygen free surfaces in the Bayard–Alpert gauges, is discussed and contrasted to the oxygen processed surfaces in the magnetron gauges flown on the Explorer 17 and 32 satellites, which apparently did not pump the ambient O. Author

N68-23890*# California Univ., Berkeley.
TECHNIQUES FOR MEASURING STRESSES IN ROCK ON THE EARTH: ADAPTABILITY TO A LUNAR EXPLORATION PROGRAM
F. E. Heuze and R. E. Goodman Huntsville, Ala. NASA Marshall Space Flight Center Feb. 1968 47 p refs
(Contract NSR-05-003-189)
(NASA-CR-61203) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Techniques and instruments for the determination of stresses in a rock mass on earth are reviewed and evaluated for application in the lunar exploration program. The methods available for assessing the state of stress in rock masses are listed and overcoring and flat jack methods are analyzed in detail. It is concluded that the design and/or lunarization of a three-component gage for an overcoring process is feasible to measure stresses in rocks on the moon. G.G.

N68-23920# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
DETERMINATION OF THE FIRST DERIVATIVES OF THE DISTURBING POTENTIAL BY GREEN'S FUNDAMENTAL FORMULA
Karl-Rudolph Koch Oct. 1967 50 p refs
(Contract AF 19(628)-5701)
(Rept.-90; AFCRL-67-0616; SR-15; AD-667540)

Simplified evaluations of the first derivatives with respect to an arbitrary direction of the potential of a simple layer and a double layer are given. The obtained formulas are used to differentiate Greens fundamental formula, which follows from Greens identities. They are checked by another method of differentiation. An application of the derivative of Greens formula in geodesy leads to a linear integral equation for the derivative of the disturbing potential with respect to the earths normal. Using a method due to Molodensky, the integral equation is transformed into an integral formula. This formula yields the first derivatives of the disturbing potential at the earths surface with respect to an arbitrary direction, if the free-air anomalies and the disturbing potential are known at the earths surface. Author (TAB)

N68-23949# General Electric Co., Schenectady, N. Y. Research and Development Center.
FISSION-TRACK DATING AND PROCESSING IN THE EARTH'S INTERIOR
R. L. Fleischer, P. B. Price, and R. M. Walker (Washington Univ., St. Louis) Jun. 1967 6 p refs
(Rept.-67-C-227)

The principles of fission-track dating are briefly noted, and it is shown how the different track retentivities of various minerals make fission-track dating of potential use in understanding the paleothermal, paleomagnetic, and paleomechanical chronology of the earth. Author

N68-23959# Stanford Univ., Calif. Dept. of Civil Engineering.
AN EXPERIMENTAL INVESTIGATION OF THE STRUCTURE OF A TURBULENT WIND OVER WATER WAVES
Susumu Karaki and En Yun Hsu Mar. 1968 117 p refs
(Contract Nonr-225(71); Grant NSF GK-736)
(TR-88; AD-667836)

This investigation presents experimental results from a study of the structure of a turbulent boundary layer developed by air flow over water waves in a lab wind-wave channel. It was demonstrated that the sheared flow region is two-layered, similar to rough wall boundary layers. The inner layer, adjacent to the wall, is describable by the law of the wall and the outer flow by the defect law. The data were taken in two-dimensional flow with small favorable pressure gradients. The first part of the two-part investigation involved air flow over an initially still water surface on which waves developed in response to wind excitation. In the second part, air was passed over water waves of a single frequency and varied amplitude. The results indicated that within the range of this study the water surface can be classed as aerodynamically rough at wind speeds greater than 12 fps and the flow structure of the boundary layer corresponds to that over a rough wall. The velocity decrement due to surface roughness is shown to be a function of the local root-mean-square wave height. The effect of wave-induced fluctuations in the air is limited to a very close neighborhood of the wavy surface. For the specific combination of wind and wave speeds of this study it was found that while the amplitudes of the horizontal components of the fluctuation decreased with increasing elevation, the vertical component increased. Author (TAB)

N68-23962 Florida Atlantic Univ., Boca Raton. Dept. of Geography.
A MULTISPECTRAL SURVEY OF A COASTAL-INTRA-COASTAL ENVIRONMENT
Richard E. Witmer 1 Apr. 1968 24 p
(Contract Nonr-4761(00))
(TR-5; AD-667610)

The technical report presents multispectral aerial imagery illustrating a coastal-intracoastal environment near Boca Raton, Florida. This imagery was generated during January and February of 1967 and includes a vertical panchromatic photograph, oblique conventional infrared and color infrared photographs, and day and night thermal infrared images. The panchromatic photograph is used as an analytic base and the individual physical and cultural geographic phenomena recorded on each of the images are analyzed and compared. Photographs of selected ground locations are used to illustrate the various geographic phenomena included within the study area. The analytic discussion also includes relative merits and disadvantages of each type of sensor and spectral band in the geographic analysis of such an environment. Author (TAB)

N68-24013# California Univ., San Diego. Marine Physical Lab.
FINE-SCALE TOPOGRAPHY AND MAGNETIC ANOMALIES OF THE DEEP SEA FLOOR OFF SOUTHERN CALIFORNIA
Michael S. Loughridge (Ph.D. Thesis—Harvard Univ.) 3 Jan. 1968 67 p refs
(Contract Nonr-2216(05))
(MPL-U-3/68; SIO-Ref.-68-2; AD-667712)

The first survey of a portion of the Pacific sea floor by means of deeply towed instruments was made in July 1965. The area surveyed off California near 123 deg 10 min W and 32 deg 40 min N was previously thought to be one of typical abyssal hills at a depth of approximately 4000 meters. Observations of the fine-scale topography and total magnetic field intensity were made with a narrow-beam echo-sounder and proton magnetometer towed within 300-500 meters of the sea floor. These observations show that the topography exhibits a linear trend in a direction which parallels the well-known Mason-Raff magnetic trends. In a direction perpendicular to this trend, the topography has a gently undulatory character with a recurrence wavelength of approximately 0.4 sq km and relief of approximately 100 meters. Speculative interpretations of the topography and magnetics are given which discuss their origin, preservation, and possible relationships to other crustal features. Instrumentation and acoustic navigation techniques are also described. Author (TAB)

N68-24043# Boston Univ., Mass.
A WORLD-WIDE INVESTIGATION OF THE MID-LATITUDE EVENING INCREASE OF THE F_0F2 IN THE SUMMER HEMISPHERE, PART 2 Final Report, 1 Nov. 1962–31 Oct. 1967
Michael D. Papagiannis and Henry Mullaney Jan. 1968 23 p refs
(Contract AF 19(628)-2350)
(AFCRL-68-0098; AD-667541)

Using the data and the computer program of the Ionospheric Predictions Services of ITSA-ESSA, we have obtained six world contour maps of the evening anomaly in an effort to establish the geographic and local time characteristics of this intriguing, but not well understood, phenomenon. Author (TAB)

N68-24066# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE MEAN TIME OF THE FREE PATH OF OXYGEN MOLECULES [O SREDNEM VREMENI SVOBODNOGO PROBEGA MOLEKUL OXYGEN]
A. K. Suslov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 89–93 refs (See N68-24058 13-06)

A photometric method of scanning the O_2 absorption line is used to derive the formula for determining the mean time of the free path. Only such lines whose intensity at the line center is zero are used. The difference between the theoretical and observed value is found. It is pointed out that this method may be used for making more precise models of the standard atmosphere. Author

N68-24067# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATION OF ISOLATED LINE DURING TRANSFER OF RADIATIVE ENERGY IN THE UPPER ATMOSPHERE [PRIBLIZHENIYE IZOLIROVANNOY LINII PRI PERENOSE LUCHISTOY ENERGII V VERKHNEY ATMOSFERE]
G. M. Shved *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 95–98 refs (See N68-24058 13-06)

The use of the approximation of an isolated line for simulation of infrared spectra of absorption in the mesosphere and upper stratosphere is possible, thanks to the decrease in the width of the line with the drop in pressure. The limits of validity of this approximation for computing flows and influxes of radiant energy are discussed. Author

N68-24079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT INFRARED SPECTRUM OF TWILIGHT SKY [OB INFRAKRASNOM SPEKTRE SUMERECHNOGO NEBA]
Ye. V. Gnilovskoy *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 195–197 refs (See N68-24058 13-06)

The data on the observation of the twilight sky in the infrared part of the spectrum of about 1.1 micron are given. Apparatus described, and typical spectrum of the twilight sky with different setting angle of the sun behind the horizon is regarded. Author

N68-24080# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHASE METHOD OF MEASURING MAGNETIC FIELD OF EARTH WITH A NUCLEAR-RESONANCE FILTER [FAZOVYY METOD IZMERENIYA MAGNITNOGO POLYA ZEMLI PRI POMOSHCHI YADERNO-REZONANSNOGO FIL'TRA]

P. M. Borodin *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 199–202 refs (See N68-24058 13-06)

The phase method of measurement of the earth's magnetic field vector by means of the nuclear resonance filter is described. This permits simultaneous measurements of the short period variations of the field as well as its slow changes. Author

N68-24093# Bonn Univ. (West Germany). Astronomische Institute.

THE UPPER ATMOSPHERE IN THE SATELLITE ORBITAL RANGE. 1: ANALYSIS OF DRAG DATA. 2: DEVELOPMENT OF APPROPRIATE ATMOSPHERIC MODELS [DIE HOCHATMOSPHAERE IM FLUGBEREICH DER SATELLITEN. 1: DAS BEOBACHTETE RAUMZEITLICHE VERHALTEN. 2: THEORIE DER MODEL LATMOSPHAEREN]

M. Roemer and H. Volland Jan. 1968 174 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung (BMWF-FBW-68-01) CFSTI: HC $3.00/MF $0.65

The physical behavior of the upper atmosphere as deduced from satellite drag data is reviewed. Emphasis is placed on the discussion of the global distribution of density and exospheric temperature and on systematic variations. Theoretical considerations on the mean temperature profile of the magnetosphere, on boundary conditions, and on the dynamical behavior of the thermosphere are presented. Development and problems in the construction of atmospheric models are reviewed. The system of hydromagnetic equations, the differential equations governing the diurnal motion of the neutral gas, and a novel treatment of the Harris–Priester model are given. Author

N68-24115 Florida Univ., Gainesville.

BEHAVIOR OF AEROSOL PARTICLES IN A THERMAL GRADIENT

Robert Stephen Sholtes (Ph.D. Thesis) 1961 131 p

Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-375

A procedure for airborne particulates was studied which uses the principle of thermal precipitation as its sampling means. This phenomenon was studied to evaluate the variables of thermal gradient, particle size, and particle thermal conductivity. Three materials, castor oil, potassium chloride, and magnesium sulfate, were studied. Each material was made into an aerosol cloud of the most homogeneous size possible and then transported into a thermal precipitation chamber where the precipitation paths of individual particles were observed and recorded by photographic means. In each case the particle precipitation velocity was shown to be proportional to the thermal gradient existing in the precipitation chamber. The particles were found to precipitate at different absolute velocities; however for the particles in the range of 5 to 15 microns in diameter, the increase in velocity due to the thermal gradient was shown to be independent of particle size and particle thermal conductivity. With larger size particles, Stokes' law appeared not to predict accurately the velocity of fall. Dissert. Abstr.

N68-24117# Bonn Univ. (West Germany). Physikalisches Institut.

A DETERMINATION OF THE NEUTRAL DENSITY AND COMPOSITION IN THE LOWER THERMOSPHERE [EINE MESSUNG DER DICHTE UND ZUSAMMENSETZUNG DES NEUTRALGASES IN DER UNTEREN THERMOSPHAERE]

K. Mauersberger, D. Mueller, D. Offermann, and U. v. Zahn Jan. 1968 75 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung (BMWF-FBW-68-05) CFSTI: $3.00

On December 11, 1965 at 0505 MET a Centaur rocket (ESRO Co7/2) was launched from the range of Salto di Quirra, Sardinia, carrying a quadrupole mass filter. The number densities of N_2, O_2, O, and Ar were determined in the altitude region from 112 km to 158 km. A high content of atomic oxygen was found. The relative Ar concentration was low, thus indicating an onset of diffusive separation well below 110 km. Author

N68-24137*# Southwest Center for Advanced Studies, Dallas, Tex.

INFRARED ABSORPTION PROGRAM Final Report, 1 Jan. 1965–31 Jan. 1968

Gilbert N. Plass 28 Feb. 1968 15 p refs Supported in part by NASA

(Contract AF 19(628)-5039)

(NASA-CR-94659; AFCRL-68-0118; AD-667214) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A number of aspects of the interaction of radiation with planetary atmospheres were studied. The variations to be expected in the transmission of radiation from thermal sources (continuous in wavelength), from flames (molecular bands), and from laser sources (essentially monochromatic) are derived. The scattering and absorption of Mie particles are studied because of the importance of aerosols in our atmosphere. Multiple scattering of light is important in any realistic model of the earths atmosphere. A sophisticated Monte Carlo method was developed to follow the path of a photon as it is scattered or absorbed by collision with atmospheric molecules, aerosols, and water droplets. Results were derived from the Monte Carlo calculations for many different conditions. The radiant intensity, flux, and polarization are calculated at arbitrary levels in the atmosphere. Author (TAB)

N68-24168# International Training Centre for Aerial Survey, Delft (Netherlands).

THE CHANGING ART OF GEOLOGICAL SURVEYING. INAUGURAL ADDRESS

Caesar Voute [1968] 29 p refs Presented at the Intern. Inst. for Aerial Surv. and Earth Sci., Delft, Netherlands, 5 Feb. 1968

The author gives a historical review on geological surveying techniques and applications from the stone age to the current century. Present fields of geological activity are highly specialized and encompass geomorphology and soil sciences, mineral resource surveys, water resource surveys, groundwater and engineering geology, aerial surveying methods, and conventional photographic mapping. Stressed is the need for interdisciplinary and interuniversitary work. G.G.

N68-24181# American Meteorological Society, Boston, Mass.

ANNUAL VARIATION OF THE ELECTRIC POTENTIAL OF THE ATMOSPHERE AT A HEIGHT OF 6000 m AND THE CHARGE OF A COLUMN OF AIR IN THE 0–6000 m LAYER [GODOVOI KHOD ELEKTRICHESKOGO POTENTSIALA ATMOSFERY NA VYSOTE 6000 m I ZARIADA STOLBA VOZDUKHA V SLOE 0–6000 m]

I. M. Imianitov and E. V. Chubarina Bedford, Mass. AFCRL Jan. 1968 26 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 9–21

(Contract AF 19(628)-3880)

(T-R-569; AD-667416)

The annual variation of space charges in the atmosphere in the 0-6000 m layer as well as the characteristics of the variation in the 0-500, 500-3500, and 3500-6000 m layers are

investigated. It is shown that the range of the annual variation is very large and may account for a significant part of the annual unitary variation of the atmospheric electric field intensity. An inverse variation of the space charges in the lower and middle layers is also noted. The principal variations of the atmospheric charge are concentrated in the middle layer. Author (TAB)

N68-24191# Technische Hochschule Munchen (West Germany). Institut fuer Astronomische und Physikalische Geodaesie.
THE ORBIT DETERMINATION PROBLEM IN SATELLITE GEODESY [ZUM BAHNBEST IMMUNGSPROBLEM DER SATELLITEN-GEODAESIE]
Manfred Schneider Feb. 1968 41 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBW-68-11; Rept.-50) CFSTI: HC $3.00/MF $0.65

A general orbit determination method allowing the determination of the earth's gravitational field and correction of station coordinates is discussed. No orbital theory and no reduction of satellite observations because of nongravitational terms is necessary. Furthermore there is no principal indeterminateness in the proposed method. The first step of the method consists of a preliminary orbit determination. For doing this a procedure has been developed, based on the main problem of satellite mechanics. Finally two further possibilities of determining or at least controlling potential coefficients are sketched. Author

N68-24202# Philco-Ford Corp., Billings, Mont. Education and Technical Services Div.
SUBARRAY E3 EXPANSION Final Report
A. E. Ronning and B. L. Ramsey 25 Feb. 1968 29 p Prepared for Lincoln Lab., Mass. Inst. of Tech.
(Contract AF 19(628)-5167; ARPA Order 512)
(P-411-24; ESD-TR-68-26; AD-667517)

An expansion and reconfiguration of a Montana LASA subarray was performed during the period October-December 1966. A description of the construction and installation of that subarray is presented. The evaluation of the array is reserved for a subsequent report. Author (TAB)

N68-24213*# Princeton Univ., N. J. Dept. of Geological and Geophysical Sciences.
THE HIGH-TEMPERATURE CREEP OF DUNITE Final Report
Jerome F. Eaton (Ph.D. Thesis) 1 Mar. 1968 145 p refs Sponsored in part by NASA
(Contract Nonr-1858(44))
(NASA-CR-94670; AD-667478) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Twenty-two creep experiments were performed on cylindrical specimens of fine-grained polycrystalline dunite. The experiments were conducted in a new, uniaxial compression apparatus at high temperatures, up to 1000C., and differential stresses up to 400 bars at atmospheric pressure. By means of slow heating up and cooling down, it proved possible to prevent crumbing and cracking of the specimens, in the absence of either jacketing or confining pressure. Primary and secondary stages of creep were observed in most of the tests. Temperature, and not axial stress, was found to have the strongest influence on the measured deformations. The investigation established a strong presumption that conditions under which creep deformation takes place in the upper mantle can be investigated in the laboratory with comparatively simple techniques. Author (TAB)

N68-24227# Boston Univ., Mass.
RAY-TRACING OF THE Z-MODE IN A TILTED LAYER IONOSPHERE, PART 2 Final Report, 1 Nov. 1962–31 Oct. 1967
Michael D. Papagiannis and David L. Miller Jan. 1968 39 p refs
(Contract AF 19(628)-2350)
(AFCRL-68-0099; AD-667542)

Rays of the Z-mode have been traced through tilted layers of the ionosphere and it was found that tilted layers can explain the occasional appearance of Z-mode echoes in ionograms. It was also found that the type of tilted layer determines the range of frequencies over which Z-mode echoes are received. This theoretical result agrees with certain ionograms which show both an intense spread-F effect in the ordinary and extraordinary echoes and a clear Z-mode echo over a limited spectral range. A method has also been developed to take into account the existence of a coupling cone around the direction of the magnetic field at $X = 1$ without going through the complicated procedure of a full wave solution. Author (TAB)

N68-24326# Utah Univ., Salt Lake City. Dept. of Meteorology.
RESEARCH ON ATMOSPHERIC TURBULENCE AND DIFFUSION Technical Progress Report, 1 May–31 Dec. 1967
S. K. Kao Jan. 1968 6 p
(Contract AT(11-1)-1585)
(COO-1585-3) CFSTI: HC $3.00/MF $0.65

Research on atmospheric turbulence and diffusion was continued. A mathematical analysis was made of the kinematics and dynamics of the relative dispersion of particles in a stratified, rotating atmosphere. Characteristics of the large-scale diffusion process at various levels in the troposphere (200, 500, and 800 mb) were investigated. Characteristics of relative particle dispersion in the atmosphere's boundary layer were studied. A preliminary analysis of the interaction of the large-scale atmospheric turbulence was conducted. The turbulence and energy variation in the upper atmosphere were examined using rocket data for the years 1963 through 1965. NSA

N68-24335# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT KANOYA, JAPAN IN 1962
1968 120 p refs
(Rept.-51) CFSTI: HC $3.00/MF $0.65

Hourly values of magnetic declination, magnetic horizontal intensity, and magnetic vertical intensity taken at Kanoya, Japan, in 1962 are tabulated. Mean hourly values of magnetic elements are given for calm days, disturbed days, and all days during 1962; and mean hourly values of north and west components are also shown, as is the general character of the principal magnetic distrubances observed during 1962. Sixty-one plates illustrate the magnetograms taken during the year. Absolute observations, variometers used, and scale and base-line values are discussed. M.W.R.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-23056# Ballistic Research Labs., Aberdeen Proving Ground, Md.
CALIBRATION OF FLUIDIC OSCILLATOR TIME MARK GENERATORS FOR SELF-RECORDING GAGES

Charles H. Hoover Dec. 1967 41 p
(BRL-TN-1675; AD-666770)

Several factors affect the operating frequency of the fluidic oscillator time-mark generator used in the mechanical self-recording overpressure-time gages. The report delineates these factors, describes the methods of calibration and reports the results thereof. The primary factors considered are changes in ambient temperature, barometric pressure (altitude), and changes in the fluid supply pressure. It is concluded from these tests that the present fluidic timers can be used under a wide range of environmental operating conditions with the application of the proper correction factor. The applications of these factors are presented. Author (TAB)

N68-23056 Tulane Univ., New Orleans, La.
FLOW STUDIES BY CORONA ANEMOMETRY IN FLUID SYSTEMS
Larry Neil Pearce (Ph.D. Thesis) 1966 78 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-3864

The derivation begins by showing that: (1) corona probes are space charge limited. (2) All of the current in the circuit is attributed to positive charge drifting across the gap. (3) The amount of positive charge in the gap is determined by the probe potential and electrode geometry. (4) Finally it is assumed and subsequently proved experimentally that air flow axial with the positive charge drift direction will increase the current by increasing the apparent ion transport velocity while the total quantity of positive charge in the gap remains constant. A method of measuring positive ion transport velocity is established. The results indicate: (1) the current change in the circuit of the corona discharge anemomenter is produced by increasing the transport velocity of the positive ions and (2) the total space charge in the gap is independent of the gap spacing and is a function of the probe potential and electrode shape. Dissert. Abstr.

N68-23121# Army Electronics Labs., Fort Monmouth, N. J.
TRANSIENT TEMPERATURE BEHAVIOR OF THE THERMAL RADIOMETER
Reinhold Marchgraber Dec. 1967 36 p ref
(ECOM-2917; AD-666771)

Radiometers with thermal (caloric) receivers show transients when exposed to changes in the temperature of their environment which falsify the measurement of radiant fluxes. Based on experimental observation, a simple mathematical model is developed. Instrumented on the analog computer, this model confirms and extends the experimental findings and indicates areas of improvements in radiometer design. The time integral of the transient is found to depend solely on the temperature difference between states of thermal equilibrium of the radiometer with its environment and not on the rate of change between these states. Author (TAB)

N68-23127# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
GAMMA DETECTING-INDICATING SYSTEM AN/GKQ-4 Technical Report, 18 Apr. 1963–15 Jun. 1967
E. G. Clements and P. A. Zielie Mar. 1968 16 p
(AFWL-TR-68-22; AD-666659)

The preliminary report describes the capabilities and operation of a prototype, wide-area, remote fallout monitor developed by the United States Air Force. This system is capable of detecting gamma intensities in a range of from 0.01 to 5000 R/hr, at up to 10 remote detecting locations, and transmitting this information by hard-line or radio telemetry to a single central location. The central station displays dose-rate information on individual meters and a single-strip chart recorder. An audio and visual alarm is given when a pre-set dose rate is reached. The system is able to operate on either 117 Vac, 60 Hz, or self-contained, rechargeable battery power in case of power failure. The final report will contain information concerning the development, design, and fabrication of this system. Author (TAB)

N68-23206# Northeastern Univ., Boston, Mass.
INVESTIGATION OF THE LIGHT SCATTERING TECHNIQUE FOR COUNTING AND SIZE DETERMINATION OF MICRON-SIZED METEORITES Final Report, 24 Sep. 1963–31 Jul. 1967
John F. Dunn, Jr., Arthur R. Foster, Theodore J. Morin, Jr., Louis J. Nardone, John L. Swanson et al 15 Oct. 1967 35 p refs
(Contract AF 19(628)-2423)
(AFCRL-67-0620; AD-666703)

The essential characteristics and basic configuration of a compact instrument intended to count and determine the size of micrometeorites by measuring the intensity of light scattered by such micron-sized particles are described. The problems associated with measurement of scattered light intensities in the forward lobe are discussed. Author (TAB)

N68-23233# Parametrics, Inc., Waltham, Mass.
ULTRASONIC THERMOMETRY IN LMFBR SYSTEMS Quarterly Progress Report, 1 Oct.–31 Dec. 1968
S. Fam, L. C. Lynnworth, and E. H. Carnevale 29 Jan. 1968 21 p refs
(Contract AT(30-1)-3906)
(QPR-1; NYO-3906-1) CFSTI: HC $3.00/MF $0.65

An ultrasonic thermometry system is being developed to automatically determine the fuel, cladding, and coolant temperatures in liquid metal cooled fast reactors. Maximum expected temperatures are 2000°F for the coolant and 5000°F for the fuel. Likely sensor materials are W, Re, Ta and Mo, for use over the whole temperature range, and possibly certain stainless steels, for use to 1600°F. Velocity and attenuation have been measured in short W and Re sensors to 5000°F, and in a 50 ft W lead-in, 20 ft of which were heated to 2000°F. Effects of coiling and simulated Na immersion were also determined. Author (NSA)

N68-23237# Atomic Energy Commission Research Establishment, Riso (Denmark).
FIXED-SCATTERING-ANGLE SPECTROMETER FOR NEUTRON-DIFFRACTION STUDIES OF POWDERED SAMPLES
B. Lebech and K. Mikke Aug. 1967 45 p refs
(RISO-164)

A fixed-scattering-angle spectrometer for neutron-diffraction studies of powdered samples operating at the DR 3 reactor at Risö is described. Several typical results obtained using this instrument are presented, and for some of them a structure analysis is performed. As an example, the redetermination of the oxygen parameter for zinc oxide and the three parameters in $PbTiO_3$ is made. The experimental and theoretically computed resolutions are compared with the resolution of a typical fixed-wavelength spectrometer. Special features of the method and future applications are also briefly discussed. NSA

N68-23253# Perkin-Elmer Corp., Norwalk, Conn. Electro Optical Div.
IMAGE DENSITY GRADIENT ANALYSIS Final Report, 12 Jan.–12 Dec. 1967
John Kelly and E. C. Yeadon Griffiss AFB, N. Y. RADC Feb. 1968 56 p refs
(Contract F30602-67-C-0100)
(RADC-TR-67-658; Rept.-9104; AD-666937)

The Image Density Gradient Analysis effort was concerned with (1) the determination of the accuracy and precision of the Perkin-Elmer Edge Gradient Analysis (EGA) technique, and (2) the modification of the EGA computer programs for use with the IBM 360 Model 30E computer. Two sets of special targets were prepared to check accuracy and precision. The first set contained edges with varying degrees of linear image motion and the second set contained an array of sinusoidal transmittance targets and a low contrast edge. The special targets were used to test the accuracy and precision of the EGA technique. The results showed that the technique was accurate and precise out to spatial frequencies of 200 cycles per millimeter. The linear motion targets were measured using the Mann Microanalyzer. The results showed that this instrument was accurate over the spatial frequency range of 0 to 100 cycles per millimeter. The EGA computer programs were modified and successfully tested on an IBM 360 Model 30E computer. Author (TAB)

N68-23342# Goodyear Aerospace Corp., Akron, Ohio.
STUDY AND DEVELOPMENT OF A SIMULATION INFINITE DEPTH OF FIELD OPTICAL PICKUP Final Report, 15 Jul. 1966–15 Sep. 1967
James A. Horton and John F. Bartucci Wright-Patterson AFB, Ohio AMRL Nov. 1967 66 p
(Contract AF 33(615)-5365)
(GER-12832S/14; AMRL-TR-67-197; AD-666939)

Sufficient depth of field is an inherent problem in all conventional optical pickup designs. The solution in the past has been to operate at higher f-numbers and accept the increased object-lighting requirements. In Phase I of this program, several techniques were investigated that utilized the Schiempflug condition to increase the depth of the field without affecting the f-number of the pickup. Of these techniques, one proving especially useful involved the tilting of the final imaging lens about its rear nodal point to compensate for the final image tilt. Author (TAB)

N68-23447*# California Univ., Berkeley. Electronics Research Lab.
RESEARCH ON FIELD-EFFECT TRANSISTOR STRESS TRANSDUCERS Semiannual Status Report, 1 Jul.–31 Dec. 1967
R. S. Muller 31 Dec. 1967 10 p refs
(Grant NGR-05-003-243)
(NASA-CR-94541) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Summary data are presented on the development of insulated gate field effect transistors (IGFET), with CdS or Te used as the piezoelectric semiconductor material. It is reported that the piezoelectric semiconductor stress-interaction theory was confirmed by comparison of the polarity and magnitude of the stress-induced charge with observed changes in the drain current of IGFET devices. Stress effects in FETs are assessed in terms of three basic configurations: the piezoelectric semiconductor, piezoelectric insulator, and piezoelectric substrate configurations. Also reviewed are techniques for metal insulator piezoelectric semiconductor transducer fabrication, theoretical calculations of minority carrier mobilities at semiconductor surfaces, and vacuum vapor-deposition process for thin film CdS–CdTe heterojunction diodes. M.G.J.

N68-23459*# Volt Technical Corp., Washington, D. C.
GROUNDMETER-PENETROMETER USED ON THE ALS LUNA 13
I. I. Cherkasov, V. V. Gromov, N. M. Zobachev, A. A. Musatov, V. V. Mikheyev et al Greenbelt, Md. NASA Goddard Space Flight Center 9 May 1968 6 p ref
(Contract NAS5-12487)
(NASA-CR-94587; ST-INS-LPS-10711) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The groundmeter–penetrometer of the automatic lunar station (Luna-13) is described, and an account is given on its operation after the soft landing of the probe on the lunar surface on 24 December 1966. Evaluation is made of the precision of the analysis of the lunar surface strength as a function of the lunar microrelief. Author

N68-23461*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Systems.
LABORATORY CONTAMINANT SENSOR Final Report
M. A. Rotheram Mar. 1968 105 p
(Contract NAS1-7266)
(NASA-CR-66606) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This final report describes development of a Laboratory Contaminant Sensor, a prototype instrument which can be reduced to space flight hardware for detection of contaminants during manned space missions. The instrument design is based on the use of an accumulator cell which contains a sorbent for extraction of contaminants from air at room temperature. By heating the cell, contaminants are desorbed through a special inlet system to a mass spectrometer for identification and determination. The performance of the instrument was evaluated by tests with typical contaminants. Three sorbents—Porapak Q, charcoal, and Molecular Sieve 5A—were used to sorb the various contaminants. A palladium-coated charcoal sorbent was prepared and successfully tested for the detection of carbon monoxide. Identification of contaminants is facilitated by the use of the three sorbents and programmed temperature desorption. The test results demonstrate that this instrument concept has considerable potential for detection, identification, and quantitative determination of atmospheric contaminants. Author

N68-23463 Missouri Univ., Columbia.
DESIGN AND CONSTRUCTION OF VISCOMETER FOR VISCOSITY MEASUREMENT OF GASES AT HIGH TEMPERATURES AND HIGH PRESSURES
Kun Sup Hyun (Ph.D. Thesis) 1966 155 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-909

A capillary flow viscometer was designed and constructed to operate at 200°C to 400°C and pressures to 475 atm. This apparatus can be divided into five basic parts: the working system, the pressure measuring system, the temperature control and measurement, the charging systems, and the evacuation system. The working system consists of (1) the high pressure cell (HPC) containing a pyrex capillary tube with a root mean-square-radius of 0.0186 cm and a length of 40.7 cm, (2) the precision metallic bellows displacement pump (PMBDP) which provides and maintains a steady-state flow through a capillary, and (3) the pump drive. The pressure measuring system includes (1) the two high temperature differential pressure indicators which separate the pressure measuring system from the working system physically, (2) the Heise Gauges for the total pressure measurements, and (3) the U-tube mercury manometer equipped with the linear variable differential transformers. Dissert. Abstr.

N68-23562# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA-8 Monthly Graphs, Sep.–Dec. 1967
J. F. Steljes Mar. 1968 71 p
(AECL-3064) CFSTI: HC $3.00/MF $0.65

Uncorrected and barometer-corrected results from the cosmic ray stations in Canada are given in tabular form for the period from September to December 1967. Normalized graphs are given for the period September 1967 to December 1967. A warning about defective barometer vacuum at two stations is included. Author

N68-23573# United Kingdom Atomic Energy Authority, Risley (England). Reactor Engineering Lab.

AN EXPERIMENTAL CONTINUOUS-INDICATION PLUGGING METER FOR IMPURITY MONITORING IN LIQUID ALKALI METALS

D. F. Davidson and P. F. Roach 1968 15 p refs

(TRG-1640(R)) HMSO: 2s 6d

Plugging meters, although non-specific, are useful for detecting changes in the gross impurity level of liquid alkali metals. For the coolant circuits of a fast reactor, automatic as opposed to manual measurement of the plugging temperature is required. The development of an experimental automatic instrument, designed to have a fast response and display a continuous record of plugging temperatures is described. The liquid metal supply to the instrument flows from zero differential pressure sampling points on the external system and circulation is maintained by using a separate pump. With this design, the flow emerging from the cooler has two alternative routes, one through the orifice and one by-passing it. The by-pass flow is guided near the orifice and aids rapid unplugging. Under automatic control, the orifice is partially blocked with impurities. The temperature of the liquid metal near the orifice is adjusted to keep orifice flow a fixed fraction of its unplugged flow (i.e. at the saturation value). This temperature is measured and indicated. Author

N68-23580# Massachusetts Inst. of Tech., Cambridge.

CONTRIBUTION TO THE KNOWLEDGE OF MAGNETIC BALANCE AND SUSPENSION SYSTEM Scientific Interim Report, Nov. 1965–May 1967

Alan Copeland, Eugene Covert, Robert Petersen, and Timothy Stephens Wright-Patterson AFB, Ohio ARL Dec. 1967 58 p refs

(Contract AF 33(615)-1470)

(ARL-67-0283; TR-139; AD-666668)

The report separates, for the purpose of discussion, into three distinct parts: comments on design studies for a large scale balance system; experimental studies of problems relating to the multiple use of an advanced configuration of coils for roll, pitch and yaw; and studies of a calibration system capable of automatic operation. The first part is a brief discussion of the philosophy behind the design. The nature of the compromises is included as well as a discussion of the performance goals for the design. The second part describes studies conducted to determine whether or not the pitching and yawing moment coil can also be used to generate rolling moments. In particular the problem of isolating the roll power supplies from the pitch and yaw power supplies, while loading the coils simultaneously, was studied in detail. It was found that this problem can be solved simply and that primary problems associated with multiple use of the coils include selection of the conductor, maximum potential and cooling. The third part contains a description of a multiple purpose calibration system. This system can either be used in the classical sense of applying the several loads and measuring the output from the data readout, or in the inverse sense that entails fixing currents in the magnetic balance and, by using the calibration system as a mechanical balance, determine the forces and moments on the model. While the latter use is unconventional it offers the promise of a fully automatic procedure. Author (TAB)

N68-23598*# Advanced Metals Research Corp., Burlington, Mass.

DEVELOPMENT OF A SCANNING ELECTRON MIRROR MICROSCOPE

R. E. Ogilvie, S. H. Moll, and M. A. Schippert Mar. 1968 69 p

(Contract NAS12-524)

(NASA-CR-86054) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A research program was carried out in order to investigate the fundamental feasibility of a scanning electron mirror microscope. This instrument, to be applied to the study of microelectronic devices uses a finely focused beam of electrons to scan the device surface. The specimen is maintained at an electrostatic potential equivalent to that of the electron gun. Electrons incident on the specimen lose their kinetic energy upon reaching the sample surface and are then reflected and reaccelerated in the opposite direction. Local variations in the potential fields at the sample surface produced by voltage junctions, differences in contact potentials, surface conductivity, topography or even magnetic fields, strongly influence the direction of the reflected electrons. The variation in the direction and intensity of the reflected electron beam seen by a detector modulate the brightness of a cathode ray tube raster, thus producing images of the electrical or magnetic characteristics of the sample surface. Author

N68-23609*# ITT Industrial Labs., Fort Wayne, Ind.

A DAY-NIGHT HIGH RESOLUTION INFRARED RADIOMETER EMPLOYING TWO-STAGE RADIANT COOLING. PART 2. BREADBOARD DAY-NIGHT RADIOMETER Final Report

R. V. Annable, J. F. Lodder, D. J. Juarez, W. H. Wallschlaeger, and P. C. Murray 28 Dec. 1967 49 p

(Contract NAS5-10113)

(NASA-CR-94603; ITTIL-67-1064) CFSTI: $3.00 CSCL 20F

Details are given on the integration of the two-stage radiant cooler into a working breadboard model of a day-night radiometer. The mechanical, optical, and electronic design of the radiometer are described, the characteristics of the infrared detector are given, and the test instrumentation is outlined. The radiometer operates in the 10.5 to 12.5 micron band and has a collecting aperture diameter of 4 inches. The mechanical drive and electronic bandwidth are designed for contiguous subpoint scanning at an altitude of 750 n mi and an instantaneous field-of-view of 2.5 mr on a side. The noise equivalent temperature is less than 170°K and the noise equivalent temperature difference at 220°K is less than 2°K. Author

N68-23707# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.

THE INSTALLED TRITIUM MONITORING SYSTEM IN THE DIDO AND PLUTO REACTOR HALLS

B. T. James Dec. 1967 18 p refs

(AERE-M-1929) HMSO: 3s 6d

A description is given of new equipment installed in the DIDO and PLUTO reactor halls for the monitoring of tritiated water in air. Each unit of the installation is provided with twelve remote sampling points, remote indication and warning facilities and the system is free from interference from high gamma radiation fields. Two standard 1844A radioactive gas monitors are used in each unit and the system has proved adequate for all operational monitoring requirements. Remote monitoring in the event of evacuation from the reactor buildings is provided. Author

N68-23710*# ITT Industrial Labs., Fort Wayne, Ind.

DAY-NIGHT HIGH RESOLUTION INFRARED RADIOMETER EMPLOYING TWO-STAGE RADIANT COOLING. PART 1: TWO-STAGE RADIANT COOLER Final Report

R. V. Annable, J. F. Lodder, R. A. Harber, and H. A. Leiter 11 Dec. 1967 158 p refs

(Contract NAS5-10113)

(NASA-CR-94600; ITTIL-1055, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20F

This part of the final project report covers a preliminary design study, and the two-stage radiant cooler. It describes the design, thermal analysis, and testing of a two-stage radiant cooler for use in a 10.5 to 12.5 micron high resolution day-night radiometer. The general design of a two-stage radiant cooler for use on an earth-oriented spacecraft in a sun-synchronous orbit is given. Specific application is made to double- and single-ended coolers

in a Nimbus-type orbit. The performance of a double-ended radiant cooler was determined by space chamber experiments simulating orbital operation. The experiments demonstrated that a second-stage temperature below 80 degrees K can be realized under realistic thermal and mechanical conditions. Part II of the final project report covers the integration of the two-stage radiant cooler into a working breadboard model of a day-night radiometer. Author

N68-23717# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

A SYNCHRONOUS DRUM STORE FOR NEUTRON TIME-OF-FLIGHT DATA RECORDING

M. C. B. Russell Jan. 1968 6 p refs

(AERE-M-2016) HMSO: 1s 2d

Proposals are made for the use of a synchronous recording drum as time of flight register and store for experimental neutron spectrometry. The drum would be driven at a fraction of chopper speed and the data from each of an array of detectors would be stored on separate "pages" of the drum surface. An outline is given of the logical arrangement for writing data onto the drum and periodically reading it off into a paper tape punch. Such a system seems to offer an alternative to the on-line connection of a data processor to the experiment. Author

N68-23726# Centre National de la Recherche Scientifique, Paris (France).

THE USE OF ELECTRONIC PHOTOGRAPHY IN LARGE DISPERSION SPECTROGRAPHY [SUR L'UTILISATION DE LA PHOTOGRAPHIE ELECTRONIQUE EN SPECTROGRAPHIE A GRAND DISPERSION]

Maurice Duchesne, Renee Herman, Jean-Michel Le Contel [1967] 6 p refs In FRENCH Reprinted Publ. de l'Observatoire de Haute Provence, vol. 9, no. 23

CFSTI: HC $3.00/MF $0.65

Spectra were obtained for gamma Pegasus with the aid of an electronic camera and high resolution spectrography. The keen sensitivity of the equipment permits observations of rapid variations in the form of line profiles and their larger equivalents. A doublet was found for Mg II, and details for this and for Si III, He I, and Al III spectra are tabulated. Transl. by M.W.R.

N68-23768# Advisory Group for Aeronautical Research and Development, Paris (France).

TECHNIQUES FOR MEASUREMENT OF DYNAMIC STABILITY DERIVATIVES IN GROUND TEST FACILITIES

C. J. Schueler, L. K. Ward, and A. E. Hodapp, Jr. Oct. 1967 227 p refs

(AGARDograph-121) CFSTI: HC $3.00/MF $0.65

Techniques in current use for measuring dynamic stability derivatives in wind tunnels are described, with emphasis on the important features of balance system design, data reduction methods, instrumentation, and typical balance systems. The use of gas bearings for dynamic stability and roll damping balances is treated, and a three-degree-of-freedom balance system employing a spherical gas bearing is described. Author

N68-23790*# California Univ., Berkeley. Lawrence Radiation Lab. Electronic Engineering Research and Development.

ELECTRONIC DETECTOR FOR PERFORMING THE S-16 PARTICLE ASYMMETRY EXPERIMENT ON AAP MISSIONS Final Report, 1 Jul. 1967–30 Apr. 1968

30 Apr. 1968 70 p refs

(Contract NAS9-5249)

(NASA-CR-92120) CFSTI: $3.00 CSCL 14B

The S-16 particle asymmetry experiment, using nuclear emulsion detectors to obtain data on the processes through which protons are injected, trapped, and lost from the inner radiation belt and the changes that occur during the solar-cycle period, is described. Parameters measured by the experiment included pitch-angle distribution, directional flux, proton flux and energy spectrum, and particle mass measurements. The laboratory prototype telescope for electronic counting and particle identification is described; and theory of its operation, circuit design, pulse height information analysis, and telescope performance are considered. Flight unit and telemetry requirements for a long-duration Apollo Applications Program mission are included; and an intercomparison is made of geomagnetic field models. M.W.R.

N68-23841# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ATTACHMENT TO METALLOMICROSCOPE FOR DIRECT OBSERVATION OF THE PROCESS OF ELECTROPOLISHING AND ETCHING OF MICROSECTIONS [PRISTAVKA K METALLOMIKROSKOPU DLYA NEPOSREDSTVENNOGO NABLYUDENIYA PROTSESSA ELEKTROPOLIROVANIYA I TRAVLENIYA SHLIFOV]

A. P. Pekarev and Yu. D. Chistyakov *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 187–189 refs (See N68-12814 13-15)

Several devices and installations exist for electrical polishing and etching of microsections, which help to check and control the amperage, voltage, electrolyte temperature, electrolyte flow and other features. The "Elipowist" installation performs electrical polishing and etching of 6 mm diameter microsections under a special metal microscope. The installation facilitates the selection of electrical polishing rates and the exposure of microstructural elements such as the grain boundary, spots, etching, etc. However, this installation is not always available and may be replaced by a standard metal microscope with an attachment. The metal is observed through a plane-parallel glass plate. The attachment is placed on the specimen table instead of the replaceable metal washer. The MIM-7 and MIM-8 microscopes with OE-23 and OE-14 objectives have magnifications from 70 to 270, with the possibility of taking photographs with a magnification of 300. Polarized light may be used for observations. Even greater magnification is possible with the MVT microscope. The attachment was used to examine the microstructure of mono- and polycrystalline-tungsten. The electrolyte was a 10% aqueous solution of sodium hydroxide. Author

N68-23922# Westinghouse Electric Co., Pittsburgh, Pa. Atomic Power Div.

DEVELOPMENT OF A BORON CONCENTRATION METER Technical Progress Report, Period Ending 31 Dec. 1967

Jan. 1968 28 p refs

(Contract AT(30-1)-3690)

(WCAP-3690-3; EURAEC-1827) CFSTI: HC $3.00/MF $0.65

The design and evaluation of two prototype boron-concentration meters are presented. One meter is based on conductivity measurements of a boric acid solution with mannitol added. The second meter is based on the neutron absorption principle, and a boron trifluoride detector is used. NSA

N68-23925 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ADAPTATION OF TIME-TO-AMPLITUDE CONVERTER FOR TIME MEASUREMENTS WITH THE USE OF SEMICONDUCTOR RADIATION DETECTORS [ADAPTACJA KONWERTERA CZAS-AMPLITUDA DO POMIAROW CZASOWYCH Z POLPRZEWODNIKOWYMI DETEKTORAMI PROMIENIOWANIA]

M. Moszynski 1967 34 p refs Transl. into ENGLISH from POLISH Submitted for publication
(IBJ-847/IA/PL) CFSTI: $3.00

The effect of time of the charge collection and of time constants of the detector-amplifier equivalent circuit on the shape of pulses delivered from the semiconductor detectors is discussed. The adaptation of the time-to-amplitude converter for cooperation with detectors is presented with regard to the possibility of measurements of detector time spreads and of coincidence measurements in nuclear spectroscopy. The coincidence curves: scintillation counter-Si/Li/ or Ge/Li/ detectors are shown. Author

N68-24009# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET-BLOC OCEANOGRAPHIC INSTRUMENTATION Surveys of Foreign Scientific and Technical Literature
Lee Boylan 1 Feb. 1968 57 p refs
(ATD-68-100; AD-667204)

The present compilation of abstracts is the first in a series on Soviet-bloc oceanographic instrumentation. The bulk of the report is devoted to individual instruments and combinations of instruments used in measuring temperature, depth, currents, oxygen, salinity, radioactive contamination, and other properties. This is preceded by some information on the state-of-the-art of oceanographic instrumentation and aspects of platform design exclusive of instrumentation. Author (TAB)

N68-24086# Royal Aircraft Establishment, Farnborough (England).
STABILITY AND CONTROL FLIGHT TESTING: SOME OF THE TEST INSTRUMENTATION REQUIREMENTS
R. Rose [1968] 14 p Presented at the 30th AGARD Flight Mech. Panel on Flight Test Instr., Montreal, Can.
CFSTI: HC $3.00/MF $0.65

The scope of stability and control flight testing and the type of physical measurements are briefly reviewed. Suggested overall accuracies for the quantities, including the effects of transducer/recording element and readout system, are stated. Particular emphasis is put on the need for good instrumentation dynamic characteristics and the need for accurate dynamic calibrations of the instruments. The overall accuracies achieved using photographic trace recording systems is of the order 2%–3%, whilst 1% is required and exceptionally, for special tests, 0.2%. The use of digital/magnetic tape systems looks attractive to meet these requirements, but flight experience has shown that the potential accuracy of this system may not be achieved. The need for proving new sophisticated instrumentation systems in real flight environments is stressed. Author

N68-24110# British Aircraft Corp., Preston (England).
FLIGHT TEST INSTRUMENTATION: THE USERS REQUIREMENTS
M. L. Henney Mar. 1967 29 p refs To be presented at the 30th AGARD Flight Mech. Panel Meeting
(AF/GEN/2)

The flight test process is examined and some tests and analysis procedures are outlined. Requirements which the airborne and ground instrumentation system must meet to improve the efficiency of the process are detailed and a general specification is suggested. These requirements are compatible with current state of the art, but possible avenues of further development are suggested. Author

N68-24139# American Meteorological Society, Boston, Mass.
AUTOMATION OF A SAMPLE COLLECTOR FOR MEASURING THE LIQUID-WATER CONTENT OF FOG BY A METHOD DEVISED BY V. A. ZAITSEV [K AVTOMATIZATSII ZABORA PROB VODNOSTI TUMANA METODOM V. A. ZAITSEVA]
L. Z. Prokh Bedford, Mass. AFCRL Jan. 1968 10 p ref Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Gidrometeorol. (Kiev), no. 48, 1965 p 121–125
(Contract AF 19(628)-3880)
(T-R-567; AD-667415)

A trap device for taking samples of the liquid-water content of fog by a method originated by V. A. Zaitsev, used in the Ukrainian Hydrometeorological Scientific Research Institute, is described. Author (TAB)

N68-24150#
FORCE FEEDBACK INERTIAL INSTRUMENTS
I. McLaren May 1967 15 p Presented at the 13th Meeting of the AGARD Flight Mech. Panel, Montreal, 30 May–1 Jun. 1967
CFSTI: $3.00

The paper deals with some of the theoretical and practical aspects of inertial transducers of the force feedback type. Some design problems are discussed and special emphasis is put on the requirements of aircraft flight test work. Author

N68-24165*# Barnes Engineering Co., Stamford, Conn.
IMMERSED THERMISTOR DETECTOR OPTIMIZATION PROGRAM, PART 1 Final Engineering Report
Frank Schwarz and Thomas Falk 31 May 1967 36 p refs
(Contract NAS5-10208; BEC Proj. 2034)
(NASA-CR-94613; TR2034-II) CFSTI: HC $3.00/MF $0.65
CSCL 14B

Final results of the immersed thermistor detector optimization research established a thin germanium-immersed bolometer with a light coat of APB blackening as suitable for Nimbus radiometer application. This sensor provides a fast time constant averaging around 700 μ sec at ambient temperatures between 0° and −25°C and at bias levels of about 0.8 V_{pk} at operating temperature; it also exhibits detectivity in the 10–12 micron band approaching the thermal noise limit for such a configuration in connection with a solid-state parametric amplifier. Included are also measurement data of the 1/f noise characteristics of detectors down to frequencies as low as 0.04 Hz. G.G.

N68-24169# Joint Publications Research Service, Washington, D. C.
LUNAR STATION TELEVISION CAMERA
A. S. Selivanov, V. M. Govorov, A. S. Titov, and V. P. Chernodanov 14 May 1968 19 p refs Transl. into ENGLISH from Tekhn. Kina i Televideniya (Moscow), no. 1, Jan. 1968 p 9–17
(JPRS-45374) CFSTI: HC $3.00/MF $0.65

The soft landing Luna-9 station transmitted images of the lunar landscape by a panoramic television camera over a radio communication channel. The station used chemical energy currents to operate the optical-mechanical scanning mechanism of the camera mounted in a spherical container on the upper part of the lunar station. Orientation was provided by four opening lobes, 4 collapsable whip antennas, and 5 narrow dihedral mirrors designed to provide stereoscopic images in a limited angle of view. The camera scanning mechanism could perform a complete circular scanning in the horizontal plane. A photomultiplier and a single stage video signal amplifier shaped its logarithmic light-signal transfer characteristics and provided response control. The camera transmitted images in the illumination range of 80–150,000 lux. G.G.

N68-24200# Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena.

DEVELOPMENT OF A CRANZ-SCHARDIN PHOTOGRAPHIC SYSTEM CAPABLE OF 10^6 FRAMES PER SECOND FOR STUDY OF BUBBLE COLLAPSE AND LIQUID JET IMPACT

C. L. Kling Jan. 1968 19 p refs

(Contract DAHC04-67-C-0007; Grant NSF GK-730)

(Rept.-07738-7-T; Rept.-08466-3-T; AROD-6310.6-E; AD-667386)

The development of a Cranz-Schardin multiple spark source photographic system, with a maximum framing rate of 1,000,000 frames per second, is described. Major items involved in the system are triggerable air-gap spark light sources, a solid state delay network, a converted portrait camera, associated optics, and mounting methods for the system. The usage and limitation of the system are also described. It is especially adapted to the study of such events as bubble collapse and high-velocity liquid impacts, and can be used in Schleiren or shadowgraph studies. Author (TAB)

N68-24214# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Eastern Science and Technology Div.

TIMING CLOCK TYPE TD-92. TECHNICAL MANUAL NUMBER B-3267

Richard Planchet 9 Jun. 1967 50 p

(Contract AT(29-1)-1183)

(EG&G-1183-288) CFSTI: HC $3.00/MF $0.65

An instruction manual is presented for the EG&G Timing Clock Type TD-92. Topics included are general information, installation operation, principles of operation, and maintenance. NSA

N68-24228 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMOELECTRIC HEAT-FLUX MEASURING ELEMENTS [TERMOELEKTRICHESKIYE IZMERITEL'NYYE ELEMENTY TEPLOVOGO POTOKA]

O. A. Geraschenko and V. G. Fedorov 15 Aug. 1967 10 p refs Transl. into ENGLISH from Sibirsk. Otd. Inst. Avtomatiki i Elektrometrii. Tr. (USSR), v. 2, 1966 p 207–210

(FTD-HT-23-689-67; AD-667704)

The knowledge of the local value of the heat flux is very important information for the understanding of processes in devices based on heat exchange. In the past no instruments were available for the measurements of heat transfer through very small surfaces in objects of arbitrary configuration. Consequently, the present authors developed universal, highly accurate and stable devices which do not generate distortions of the original physical process. The units are based on differential thermocouples using thermoelectrode materials as auxiliary walls generating a temperature difference proportional to the heat flux. Author (TAB)

N68-24243# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CRYOSTAT FOR THE SF-4 SPECTROPHOTOMETER [KRIOSTAT DLYA SPEKTROFOTOMETRA SF-4]

T. Sh. Davitashvili 14 Aug. 1967 8 p refs Transl. into ENGLISH from Fiz. Nizkikh Temperatur. Tr. Inst. Fiz., Akad. Nauk Gruz. SSR (Tiflis), no. 1, 1964 p 101–102

(FTD-HT-23-687-67; AD-667648)

The article describes in detail the construction of a metallic cryostat for the measurement of optical absorption spectra in the temperature interval 85–300K using the SF-4 spectrophotometer. The cryostat is sufficiently simple and makes it possible to carry out measurements on three samples simultaneously. Not more than 50–60cc of liquid nitrogen is consumed per hour in maintaining the attained temperature. Author (TAB)

N68-24244*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF TEMPERATURE MEASUREMENTS IN 300° TO 1100°K LOW-DENSITY AIR USING AN ELECTRON BEAM PROBE

William W. Hunter, Jr. Washington May 1968 37 p refs

(NASA-TN-D-4500) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Laboratory measurements of rotational and vibrational temperatures have been performed over a range from 300° to 1100°K in static low-density air with an electron beam probe. Rotational-temperature measurements were made from the (0,0) band of the first negative system of the nitrogen constituent of air. Some tests were also performed by using the (0,1) band of the first negative system of nitrogen. No substantial differences were noted between the results of the (0,1) band tests and those of the (0,0) band tests. The accuracy of the measured rotational temperatures was found to vary with gas temperature and gas number density. A difference existed between the measured rotational temperature and the gas temperature. This difference increased with increasing gas temperature. With the inclusion of an experimentally determined correction for the gas-number-density effect, the rotational-temperature measurements were made with an accuracy that varied from approximately 0 to −6 percent with increasing gas temperature. Vibrational-temperature measurements were made by using the intensity ratios of the (0,1) and (1,2) bands of the first negative system of nitrogen. The measurements were found to be within ±20 percent of the gas temperature. Author

N68-24255# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.

POSITIVE ION SENSING SYSTEM FOR THE MEASUREMENT OF SPACECRAFT PITCH AND YAW, AIR FORCE D-10 EXPERIMENT FLOWN ON GEMINI 10 AND 12

R. C. Segalyn and M. Smiddy Dec. 1967 61 p refs *Its* AF Surv. in Geophys., No. 201

(AFCRL-67-0158; AD-667803)

An attitude sensing system utilizing the properties of ambient positive ions was developed and successfully flown on Gemini Spacecrafts X and XII. In this device the outputs of two planar electrostatic analyzers mounted symmetrically about the appropriate axis are combined to give directly pitch and yaw angles. Comparison of the flight results with those obtained simultaneously with an on-board inertial guidance system shows that over the angular range for which the ion sensing system was designed, plus or minus 20 deg, the average values are in good agreement. The in-flight results also provided a unique description of the distribution of charged particles around the spacecraft, including the wake region, and new information on the motion of the neutral winds and the mean ion drift motion in the upper atmosphere relative to the earths rotation. The system could be readily adapted or modified for automatic control of manned or unmanned rockets, satellites, or supersonic aircraft. Significant reductions in required weight, power, volume, warm-up time, response time, and cost make this a potentially valuable tool for future space flight. Author (TAB)

N68-24270 Naval Ship Engineering Center, Philadelphia, Pa.

THE DYNAMIC RESPONSE OF THERMOMETER-WELL ASSEMBLIES Final Research and Development Report

David R. Keyser 15 Mar. 1968 78 p refs

(AD-667730)

This report presents several methods of predicting the dynamic response of separable sensor thermometry systems based on experimental work. Thermometer wells of various designs were tested to disclose the effect of each conceivably significant variable. One-dimensional and two-dimensional lumped parameter models of the thermometric system were constructed and gave acceptable agreement with the experimental results. These models can be used to predict the dynamic behavior of any similar thermometer system. Author (TAB)

N68-24275# California Univ., San Diego. Marine Physical Lab.
A DOPPLER SHIFT FLOWMETER
E. D. Squier [1967] 6 p Prepared for the ISA Marine Sci. Instr. Symp., Florida, 16–19 Jan. 1968
(Contract Nonr-2216(05))
(MPL-U-48/67; AD-667710)

A water current meter and the results of its use aboard the Floating Instrument Platform, R/P FLIP, is discussed. Water currents are measured by projecting a 9 MHz acoustic beam and measuring the doppler shift frequency in the backscatter from a small volume of water. Data were gathered at various locations in the Pacific Ocean. Measurements were made to determine the flow profile, the level and spectral content of returns at various depths to 700 m. The discussion of the instrument includes receiver noise, transmitter power and streaming from the transducer face. The development of an instrument that will measure two components of flow is presently underway. Author (TAB)

N68-24292*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE JPL STANDARD TOTAL-RADIATION ABSOLUTE RADIOMETER
J. M. Kendall, Sr. 15 May 1968 15 p refs
(Contract NAS7-100)
(NASA-CR-94609; JPL-TR-32-1263) CFSTI: HC $3.00/MF $0.65 CSCL 20F

This primary standard radiometer is designed for accurate calibration of other radiometers used to measure intensity levels of solar sources in space simulators, measuring either collimated or hemispherical radiation with equal accuracy. Surrounded by a thermal guard in the standard radiometer is an isothermal quasi-spherical cavity giving increased effective blackness of the aperture. These and other features provide an absolute accuracy of 1/2% or better in measuring absolute total-radiation intensity, which is an appreciable improvement over the cone-type absolute radiometer. Other improvements include improved electronic equipment and determinations of and allowances for miscellaneous disturbances which, if not allowed for, would total no more than 1%. Temperatures in the radiometer are measured to an accuracy of 0.04°C by platinum resistance thermometers. An absolute determination of the Stefan–Boltzmann constant has been made that agrees with the theoretical value to within 1/2%. Cavity temperatures at which infrared energy was emitted for determining the Stefan–Boltzmann constant ranged from 26° to 136°C (peak energy from 10 to 7 μm). Author

N68-24300# Denver Research Inst., Colo.
DEVELOPMENT OF A HIGH TEMPERATURE LIQUID METAL SOLUTION CALORIMETER Technical Report, Jul. 1965–Jan. 1968
M. J. Pool and J. R. Guadagno Wright-Patterson AFB, Ohio AF Mater. Lab. Mar. 1968 28 p
(Contract AF 33(615)-2666)
(DRI-2451; AFML-TR-68-66; AD-667190)

The object of this project was to design and construct a liquid metal solution calorimeter capable of operating at temperatures up to 1300C. With this temperature capability, a variety of solvents, including tin, uranium, lanthanum, glasses, and certain organic salts can be used, permitting thermodynamic analysis of nearly all alloys and many inorganic compounds including such materials as steels, refractory metal alloys, carbides, borides, and silicides. Because of the high temperatures involved, interior parts are made of refractory metals and ceramics. A block of beryllia is employed as a heat sink, and high purity alumina is used for other parts. Heat is supplied through molybdenum wire resistance windings and controlled by a proportioning controller. Temperatures are measured with W-3% Re vs. W-25% Re thermocouples. A 48-junction thermopile of the same material detects temperature changes in the solvent bath due to solution of a sample; the resulting signal is amplified and recorded automatically. Insulation composed of alternate layers of nickel foil and Fibrefrax paper, which, like the remainder of the calorimeter, operates in vacuum, helps reduce the size of the apparatus. A semi-automatic system for insertion and removal of the bath permits such operations without breaking vacuum or reducing the calorimeter temperature. Samples can be dropped from temperatures ranging from -195 to 1200C, in either vacuum or inert gas atmosphere. Author (TAB)

N68-24315 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
HIGH TEMPERATURE, VACUUM X-RAY CAMERA FOR STRUCTURAL INVESTIGATIONS OF METALS AND ALLOYS [WYSOKOTEMPERATUROWA KAMERA RENTGENOWSKA DO BADAN STRUKTURALNYCH METALI I STOPOW W PROZNI]
Zbigniew Baran, Stanislaw Banach, and Roman Czarnecki 1967 28 p refs In POLISH, ENGLISH summary
(IBJ-869/XIV/PS) CFSTI: $3.00

The high temperature, vacuum X-ray camera for back Debeye or Laue diffractograms from flat metallographic samples on a flat film is described. In the case of coarse polycrystalline samples the movement of the sample ascertains homogenous intensity of Debeye rings. The range of temperatures is from room temperature to 800°C. The stability and accuracy of the temperature measurement is ±5°C. The sample is placed in a special holder and heated by radiation from an electric lamp (1000 Watts), that is focused by a mirror on the sample. This method permits continuous regulation of the sample temperature by means of changing the power of the lamp. A high vacuum of about 10^{-6} mm. in the camera gives the possibility of investigating easy oxidable specimens. The accuracy of the lattice constants measurements is about 0.005 Å. Author

N68-24327*# Panametrics, Inc., Waltham, Mass.
ULTRASONIC MEASUREMENT OF CORE MATERIAL TEMPERATURE, PHASE 1
M. S. McDonough, L. C. Lynnworth, and E. H. Carnevale Dec. 1967 44 p refs
(Contract NAS3-10284)
(NASA-CR-72395) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A pulse-echo ultrasonic system was used to determine temperature by measuring the round trip transit time in a Re wire sensor. Measurements on Re were conducted up to 6216°R in carbon-free vacuum, and up to 4800°R in a graphite environment. Above ≈3500°R, enough carbon diffuses into the Re sensor in one hour to perturb the transit time/temperature calibration. A sheath is therefore required, to avoid this calibration shift, and to permit operation beyond the Re/C eutectic. Temperatures were also measured at two different locations on one line using two different modes of vibration. Author

N68-24341*# Ling-Temco-Vought, Inc., Dallas, Tex. Research Center.
STUDY TO DETERMINE THE UTILITY OF SPECTRUM TO DOSE CONVERSION Final Report
30 Apr. 1968 34 p refs
(Contract NAS9-7565)
(NASA-CR-92104; Rept.-0-71100/8R-5) CFSTI: HC $3.00/MF $0.65 CSCL 20F

It is the purpose of this effort to demonstrate the utility of the pulse height to dose conversion system, in conjunction with the beta–gamma spectrometer, as such a system. This effort will also provide a conceptual electronic design of a system utilizing the beta–gamma spectrometer as a real time dosimeter for separate or mixed fields of both electrons and gamma rays. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-23086# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF PRACTICE FOR COMPOSITE ROLLING OF STRUCTURAL METAL PANELS Quarterly Progress Report, 15 Aug.–15 Nov. 1967
J. R. van Orsdel, D. N. Williams, and E. S. Bartlett Watertown, Mass. Army Mater. and Mech. Res. Center Feb. 1968 19 p
(Contract DA-19-066-AMC-308(X))
(AMMRC-CR-66-0216; QPR-6; AD-666751)

Initial studies performed on small laboratory-size panels indicated that Rene 41 is amenable to roll-diffusion bonding. However, completely satisfactory practice has not yet been defined. In addition, the experimentation has shown that Ti-Namel steel is a superior support material in promoting bond development in Rene 41 while SAE 1020 steel was found to be unsatisfactory. Laboratory-size titanium panels with beryllium-stiffened skin sheets were fabricated with encouraging results. Short-term plans are to continue development of both Rene 41 and titanium-beryllium composite structures. Author (TAB)

N68-23358*# Chrysler Corp., Huntsville, Ala.
DESIGN HANDBOOK UMBILICAL LOCKING MECHANISM DEVELOPMENT PROGRAM
David L. Cusick Washington NASA May 1968 72 p
(Contract NAS8-20649)
(NASA-CR-1021) CFSTI: HC $3.00/MF $0.65 CSCL 13E

This handbook presents the techniques, developed in an intensive testing program, for use in designing ball-lock mechanisms for use on space vehicle umbilicals. In addition to the general design of this locking device and its component parts, this handbook covers the effects of component surface conditioning, temperatures from ambient to minus 196 degrees Centigrade (°C), materials and material hardness, and forces on the locking device up to 5000 pounds. Author

N68-23379# Atomics International, Canoga Park, Calif.
SAMPLING BLANKS FOR THE LMFBR CLADDING PROGRAM
E. W. Murbach 30 Jan. 1968 18 p refs
(Contract AT(04-3)-701)
(NAA-SR-12616) CFSTI: HC $3.00/MF $0.65

An investigation of the blanks associated with sampling of loops and retorts in use on the LMFBR cladding program was carried out. The blank for the flow-through samplers used on loops was determined by treating pieces of tubing with amalgam prepared from low-oxygen sodium and measuring the increase in oxygen content of the amalgam. The blank for stainless steel tubing is 3.2±0.8 ppM oxygen, and for nickel tubing is 2.0±1.0 ppM oxygen. The blank for the retort sampler was determined by sampling the supply loop simultaneously with a flow-through and retort sampler. This blank was found to be 7.4±1.5 ppM oxygen. Author (NSA)

N68-23409*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF INERTED LUBRICATION SYSTEMS FOR TURBINE ENGINES
R. L. Johnson, W. R. Loomis, and L. P. Ludwig [1967] 27 p refs Presented at the ASME Gas Turbine Power Div. Conf., Washington, D. C., 7 Mar. 1968
(NASA-TM-X-61086; E-4289) CFSTI: $3.00 CSCL 13I

Inerted lubricating systems containing 125 mm ball bearings and 6.33 inch diameter face contact seals were operated in simulated turbine engine sumps at speeds to 14000 rpm and temperatures to 800°F. The ball bearings operated satisfactorily to 600°F under 3280 pounds thrust load with 4 of the 5 lubricants evaluated. A persistent problem encountered was wear and leakage of the shaft seals. Additional experimental studies and analysis identified seal thermal deformation as a major factor in seal wear and leakage. New seals, revised to mitigate thermal deformations, were designed, analyzed, and subjected to preliminary experimental studies. Author

N68-23439*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
JOINING REFRACTORY/AUSTENITIC BIMETAL TUBING Supplemental Report
J. N. Kass and D. R. Stoner [1967] 33 p
(Contract NAS3-7621)
(NASA-CR-72353; WANL-PR-(ZZ)-002) CFSTI: HC $3.00/MF $0.65 CSCL 13K

Bimetal tubing produced by four manufacturing processes was evaluated on the basis of bond integrity, dimensional control, and surface condition. The bimetal tubing, consisting of a stainless steel clad on a tantalum or columbium inner liner, was fabricated by: co-extrusion and drawing; explosive bonding and drawing; explosive bonding to size; and chemical vapor deposition. The primary evaluation criterion was the best bimetal bond quality obtainable as determined by ultrasonic inspection and metallography. The extruded and drawn tubing displayed the best combination of bond quality and dimensional control. Explosively bonded to size tubing had inherent defects at the "standoff" dimples required for explosive bonding. This tubing displayed the best control of bimetal layer dimensions. Other dimensional properties such as out of roundness were average. The explosively bonded and drawn tubing displayed unbond areas coupled with bondline voids and poor dimensional control. The tubing produced by chemical vapor deposition was of very poor quality. The refractory metal component was severely contaminated with carbon producing complete unbonding and a very brittle inner liner. The evaluation does not fully reflect the potential of the various process techniques; because either very small quantities of tubing were produced or in the one case where adequate quantities were produced, only a limited sample was evaluated. Author

N68-23467*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROPOSED STANDARDS DESCRIBING AND ESTIMATING LEAKS IN AEROSPACE HARDWARE
J. E. Decastra and F. E. Wells 12 Feb. 1968 21 p
(NASA-TM-X-53692) CFSTI: HC $3.00/MF $0.65 CSCL 13H

This report presents the results of a study undertaken to establish a standard nomenclature for missile plumbing leaks as found with liquid leak detection solution. This standard is needed so that an observed leak can be described quantitatively in a manner understood by all personnel involved in inspection, testing, and evaluation. Fitting leaks are divided into two types, threaded and flanged, and each type is divided into three classes according to standard cubic inches per minute. Author

N68-23495*# Chrysler Corp., New Orleans, La. Space Div.
GATE VALVE, MANUALLY OPERATED 6 INCH, 150 POUND PACIFIC VALVE COMPANY PART NUMBER S8550F(8)-12T-ASA Test Report

31 Oct. 1967 46 p
(Contract NAS8-4016)
(NASA-CR-94589) CSCL 13K

This report presents the results of tests performed on Gate Valve 75M12930 LGV-IC following a design modification recommended by the manufacturer. The design modification replaced the bronze upstream wedge with a stainless steel, Teflon-surfaced wedge. With this modification, the valve had a stainless steel, Teflon-surfaced wedge in both upstream and downstream positions. The following tests were performed: (1) wedge installation, (2) proof pressure, (3) functional, (4) high temperature, (5) surge, (6) cycle, and (7) burst. With the addition of a second stainless steel, Teflon-surfaced wedge, the test specimen met the requirements. Author

N68-23526*# Dow Chemical Co., Freeport, Tex.
STUDY TO DETERMINE AN IMPROVED METHOD FOR APOLLO PROPELLANT SYSTEM DECONTAMINATION AND PROPELLANT TANK DRYING Summary Report
H. G. Smith, J. C. Williams, and G. C. Mattson [1967] 12 p
(Contract NAS9-4605)
(NASA-CR-62068) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A summary is presented on an experimental study conducted to obtain a decontamination method for the Apollo propulsion system which does not involve long time periods or large quantities of materials. Phase one included studies on (1) compatibility of solvent with propellant and components, (2) method of decontamination, (3) efficiency of solvents, (4) temperature effects, (5) diffusion rates of propellants from the elastomers, and (6) removal of propellants from flushing solvents. Phase two of the study includes design, construction, and operation of a test unit which was used to compare the present method of single-flush cleaning with the proposed method of pressure-cycle vapor-phase cleaning. The costs of the two methods were estimated and compared, and the advantages of the vapor-phase cleaning are delineated. B.S.D.

N68-23583# Rochester Univ., N. Y. Nuclear Structure Research Lab.
GOLD WIRE SEALS FOR ULTRA-HIGH VACUUM
Roman A. Hawrylak 1967 19 p refs Supported in part by NSF
(PB-177429)

Advantages of gold as sealing material for ultra-high vacuum are discussed. A new configuration of unpolarized rotatable ultra-high vacuum flanges, sealed with a gold wire gasket, is described. Use of gold wire for sealing irregularly shaped openings, glass windows, and thin foils in vacuum systems is also discussed. Author (PB)

N68-23650# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
EQUIPMENT FOR INVESTIGATING THE THERMAL STRESS FATIGUE BEHAVIOR OF SAP
R. H. van Enk Brussels Mar. 1968 30 p refs
(EUR-3899.E) CFSTI: HC $3.00/MF $0.65

This paper contains a detailed description of the equipment for investigating the thermal stress fatigue behaviour of SAP (10% oxide). It is intended to use this material as a pressure tube in the ORGEL-reactor. The paper surveys the problems raised by the investigation progamme, and their solutions (e.g. the temperature measurement of the thin-walled SAP test specimen). In addition the report also contains the results of the first test series. Author

N68-23659*# Bendix Corp., Davenport, Iowa. Instruments and Life Support Div.
CRYOGENIC STORAGE SYSTEMS DESIGN, FABRICATION AND EVALUATION, VOLUME 1 Final Report
27 Mar. 1968 99 p
(Contract NAS9-5491)
(NASA-CR-92218; Publ.-3861A-68, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Vessel and shell fabrication as well as prototype thermal and structural model fabrication are discussed for long mission, lightweight cryogenic storage systems design. Cryogenic vessel thermal/thermodynamic design and management were evaluated; and the thermal design approach was to differentiate the heat transfer modes and then to maximize the control of each basic heat transfer mode. Vapor cooling, found to be most effectively applied to a radiation mode heat transfer, should be applied first to the innermost cold insulation regions. Vapor cooling was inefficient when applied to a conductivity mode. Cryogenic storage system weight is dependent upon thermal design, and significant weight improvement steps are tabulated for the system. The lower pressure cylindrical vessels were fabricated by the Ardeform process from low silicon 301 stainless steel; the spherical vessels for both high and low pressures were made of Inconel 718 and outer shells of 6061 aluminum, both by inturgescent bulge forming. A detailed system description is included for the thermal mode fabrication; and dewar fabrication and the external cradle mount structure are described for the structural model. M.W.R.

N68-23723*# Boeing Co., Seattle, Wash.
RESEARCH AND DEVELOPMENT FOR FABRICATING A SIMULATED TITANIUM ALLOY BASE GORE SEGMENT, LOWER BULKHEAD, FOR THE S-1C FUEL TANK, VOLUME 1 Final Report
Huntsville, Ala. NASA. Marshall Space Flight Center Apr. 1968 189 p
(Contract NAS8-20534)
(NASA-CR-61638; D2-109002-1, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Design requirements and processes were established for fabricating an S-IC fuel tank base gore from 8Al–1Mo–1V titanium, thereby establishing the capability for fabricating large titanium aerospace components with reduced weight and increased reliability. State-of-the-art advancements were made in producing large titanium plates; titanium-to-titanium diffusion bonding; and in the development of a low cost, high temperature ceramic die for titanium forming. Technique improvements were also made in titanium hot flattening, and ultrasonic inspection of diffusion bonded structure. Processing methods were developed for producing 8 ft × 13-1/2 ft. 8Al–1Mo–1V titanium plates. The titanium base gore design, sized to have an equivalent load carrying ability to the present 2219-T87 aluminum alloy gore, has a calculated weight of 211 pounds. This is a weight reduction of 65 pounds or 23.6 percent. The design, tooling, and fabrication methods were demonstrated by diffusion bonding a ring doubler to a full size 8Al–1Mo–1V titanium plate, then sculpturing this assembly in the flat and "hot" vacuum forming it to contour. Author

N68-23731*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
APOLLO COMMUNICATIONS SYSTEM SUPPORT. IMPROVEMENTS IN CONTACT PRINTING AND METAL MASKING TECHNIQUES Final Report, 1 Aug. 1967–29 Mar. 1968
C. J. Taylor and D. S. Herman 29 Mar. 1968 71 p refs
(Contract NAS9-6636)
(NASA-CR-92103) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Methods of producing contact prints into an emulsion or chromium coated glass plate were investigated. Resolution of one to five micrometer lines were investigated. The three methods tested were: (1) The washout technique where chromium was evaporated over a resist pattern; (2) the formation of a resist pattern over chromium evaporated on a glass plate; and (3) the conventional

contact printing of emulsion masks with consideration for very high resolution. Positive and negative resists were examined for the chromium pattern formation. A method is given for improving resist adhesion to the glass substrate. A process for hardening the chromium is also given. Chromium evaporation techniques are described that limited pinholes to five per square inch. A contact printer was designed, built and tested for high resolution printing. The contact printer was designed to expose photoengraving resists as well as silver halide emulsions. Line widths and slots widths as small as 50×10^{-6} inches were produced on chromium as well as emulsion masks. There was no indication that this was a limiting size. Author

N68-23791*# Boeing Co., Seattle, Wash.
RESEARCH AND DEVELOPMENT FOR FABRICATING A BERYLLIUM AND BERYLLIUM–TITANIUM COMPOSITE PANEL, VOLUME 2 Final Report
Huntsville, Ala. NASA. George C. Marshall Space Flight Center Apr. 1968 46 p
(Contract NAS8-20534)
(NASA-CR-61637; D2-109002-1, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Process development during fabrication of beryllium–titanium composite panels was studied; and the quality of a Y-12 Be ingot sheet displayed surface roughness, thickness variations, and pinholes. There was microcracking of the Be during forming and resistance brazing, as well as severe face warpage during electron beam brazing. Details are presented for the Be panel forming, core forming, resistance brazing, and electron beam brazing procedures; and it is recommended that the latter brazing be discontinued because of the warpage it fosters. Both improved sheet rolling techniques and additional rolling facilities are considered necessary for the fabrication of Be sheets that will meet structural requirements. M.W.R.

N68-23792*# Bendix Corp., Davenport, Iowa. Instruments and Life Support Div.
CRYOGENIC STORAGE SYSTEMS DESIGN, FABRICATION AND EVALUATION. VOLUME 2: APPENDICES. 1. SUMMARY OF CRYOGENIC STORAGE SYSTEM EVALUATION. 2. ARDEFORM PRESSURE VESSEL PROGRAM Final Report
27 Mar. 1968 237 p
(Contract NAS9-5491)
(NASA-CR-92119; Publ.-3861A-68, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Metals analysis, welding and plating processes, and fabrication processes are summarized for cryogenic storage system design, with emphasis placed on cryogenic tankage with outside diameters of 20 inches or larger than can be used on long duration space missions. Fabrication processes investigated include Ardeforming, chemical milling, electroforming, explosive forming, forging, hydroforming, inturgescent forming, machining and milling, and spinning. Pressure vessel and outer shell characteristics are described, including a buckling tests summary for the latter. Honeycomb sandwich fabrication, insulations, support systems, external support structures, and vehicular attachments were also considered. The inspection and test plan for an Ardeformed 39 inch cylinder is detailed. M.W.R.

N68-23814# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF INSTITUTIONS OF HIGHER LEARNING: NONFERROUS METALLURGY [IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA]
29 May 1967 231 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-20; AD-666896)

The document contains 29 articles on USSR scientific research in fields relating to non-ferrous metallurgy, including physical and chemical properties and reactions. TAB

N68-23819# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF ULTRASONICS IN NONFERROUS METAL TECHNOLOGY [PRIMENENIYE UL'TRAZVUKA V TEKHNOLOGII TSVETNYKH METALLOV]
I. A. Yakubovich, B. A. Agranat, O. D. Kirillov, and N. N. Khavskii *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 27–35 refs (See N68-23814 13-15)

For the investigation of the ultrasonic effect on the hydrometal and liquid dressing processes, quartz or ceramic piezoelectric crystals were used as emitters. The high-frequency oscillation in air was created by a static acoustic siren. The sinusoidal impulses from a magnetostriction vibrator and the powerful ultrasonic oscillations from the high-voltage discharges generated oscillations in the liquid. Under the ultrasonic impulses the oxide film is removed from the surface of sulfide minerals during flotation and the oleic acid is desorbed from non-sulfide minerals, and the soft minerals such as molybdenite and hydrocervantite are dispersed. Low-frequency impulses originated by the acoustic siren destroy stable mineralized foam in 4 sec., vs. 4 hrs. for unaided disappearance. In general, the application of ultrasonic oscillations proved to be useful in dust collecting, mass exchange in the system liquid–liquid, in prevention of boiler scale, in anodic dissolution of metals, and in improvement of electroplated deposits. Author

N68-23836# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF SOLDERING OF ALLOY VT3-1 TO STEELS 1Kh18N9T AND EI69 [ISSLEDOVANIYE PAYKI SPLAVA VT3-1 SO STALYAMI 1Kh18N9T I EI69]
A. A. Onopriyenko and N. M. Pul'tsin *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 153–157 (See N68-23814 13-15)

Four silver-base brazing alloys were tested in high-frequency and furnace brazing of VT3-1 titanium alloy to 1Kh18N9T and EI69 steels in vacuum or in argon atmosphere. An alloy containing 7% copper and 15% manganese yielded joints with the highest strength, 18.1 kg/mm^2, the most uniform structure, and a microhardness roughly equal to that of VT3-1 alloy. Satisfactory results were also obtained with pure silver and an alloy containing 30% copper and 10% tin. However, hard and brittle diffusion layers were formed in the pure silver–steel interface. The fourth alloy, containing 7% copper, 17.5% manganese, 3% nickel, and 0.5% silicon, yielded the least satisfactory results. At brazing temperature, β-titanium dissolves a considerable amount of manganese. Upon cooling, the solid solution decomposes with precipitation of a brittle intermetallic compound, which raises the microhardness of the brazed joint to 740 kg/mm^2. High-frequency brazing in argon was found to be the most suitable method, especially for brazing simply shaped parts in small lots. Author

N68-23839# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CHARACTER OF THE DEPENDENCE OF DEFORMATION RESISTANCE ON THE DEGREE OF DEFORMATION IN RECRYSTALLIZATION PROCESSES IN PRESSURE TREATMENT OF METALS [O KHARAKTERE ZAVISIMOSTI SOPROTIVLENIYA DEFORMIROVANIYU OT STEPENI DEFORMATSII V ZAREKRISTALLIZATSIONNYKH PROTSESSAKH OBRABOTKI METALLOV DAVLENIYEM]
I. L. Perlin, Yu. P. Glebov, and M. Z. Yermanck *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 171–178 refs (See N68-23814 13-15)

It has been proven that for pressure working of metals the strain resistance S (yield point at high strain) should be selected with consideration of the effect of the rate and degree of strain. The value of S_d may be found correctly for relative strains up to 50% (rarely to 70%). As the temperature increases, the

maximum S_d is shifted toward lower relative strain values. In the present paper, the authors derive methods for finding S_d depending on the degree and rate of stress at high degrees of strain. It was found that the hardening process changes along a damped curve as the degree of strain increases, showing that the accumulated internal energy of deformation approaches a certain maximum. Two types of strain are considered in the paper. In the first, at a constant temperature, the effect of heat is not considered, while the stress rate is varied from sample to sample but is constant for each sample. The second type is at various temperatures, but at a constant strain rate. On the basis of these tests, it was found that S_d increases at first and then decreases after reaching a certain maximum. Author

N68-23840# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEPOSITION OF GALVANIC RHENIUM CLADDING ON MOLYBDENUM AND TUNGSTEN [NANESENIYE GAL'VANICHESKIKH RENIYEVYKH POKRYTIY NA MOLIBDEN I VOL'FRAM]

I. M. Kvokova and V. I. Layner *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 179–186 refs (See N68-23814 13-15)

A number of rhenium-containing electrolytes were tested in an effort to obtain satisfactory-quality rhenium coatings on molybdenum and tungsten. The best results were obtained with electrolytes containing either 60 g/1 $HReO_4$, 40 g/1 H_2SO_4, and 30 g/1 $(MH_4)_2SO_4$ or 12 g/1 KRO_4, 60 g/1 H_2SO_4, and 100 g/1 $(NH_4)_2$ at room temperature and a current density of 20 a/dm^2. Molybdenum or tungsten surfaces had to be pickled prior to coating in 15% NaOH solution with alternating current at a current density of 30 a/dm^2. Under these conditions, rhenium coatings, 2 μ thick, and sufficiently dense, with good adhesion to the base metal were obtained. Efforts to obtain coatings with a thickness in excess of 2 μ failed; with prolonged electrolysis, the coating became nonuniform and began to peel off. Heavier coatings could be obtained only depositing several layers, each 2 μ thick, with annealing of each layer in inert gas at 800°C or 1000°C for 20 or 10 min, respectively, prior to depositing the rest layer. Author

N68-23842# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONTROL OF THE PROCESS OF DRYING OF CHARGE IN REVOLVING FURNACES WITH APPLICATION OF PROGNOSTICATING MODELS [UPRAVLENIYE PROTSESSOM SUSHKI SHIKHTY VO VRASHCHAYUSHCHIKHSYA PECHAKH S PRIMENENIYEM PROGNOZIRUYUSHCHIKH MODELEY]

V. A. Ivanov, D. I. Lisovskiy, and M. R. Shapirovskiy *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 191–203 refs (See N68-23814 13-15)

Drying of concentrate is an intermediate stage in the continuous technological process of roasting a granulated copper–zinc charge. Drying may be divided into two periods; heating of the material and evaporation of the moisture. Control of these two periods is necessary to insure that the charge enters the granulator with a constant humidity. Automatic controls are applicable to revolving furnaces. Article describes suitable proposed methods of achieving such adequate controls in a computerized system which affords a prognosticating capability. Author

N68-23882 General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.

A MATHEMATICAL MODEL FOR THE DYNAMIC EFFECT OF THE MOVING LOAD ON GEAR TEETH Technical Information Series

R. A. Thompson Aug. 1967 30 p refs
(Rept.-67-C-330)

The work reported here was developed in an attempt to see if the dynamic behavior of an isolated gear tooth, treated as a cantilevered beam independent of the gear wheel is significant. Only the kinematics of the moving tooth load are considered so that the wave equation of dynamic elasticity theory can be solved for the tooth's shear deflections by transferring the problem into the Laplace frequency domain and using a Green's function to solve the resulting boundary value problem. The solution for the shear deflections is used to evaluate the tooth's stress field from which some conclusions are drawn concerning its dynamic loading. It is shown that a dynamic shear stress occurs as a result of the moving tooth load and that as a result of reflected tooth separation shocks a considerable fatigue loading may occur after a tooth has completed its load cycle. The fatigue loading has its maximum effect at the root where tooth failure usually occurs. Author

N68-23900*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE RELEASE OF HYDROGEN ON BALL MILLING CHROMIUM IN WATER

Alan Arias Washington May 1968 23 p refs
(NASA-TN-D-4569) CFSTI: HC$3.00/MF$0.65 CSCL 13H

During the ball milling process, chromium powder reacted with the water used as the grinding medium, and hydrogen was evolved. A film composed of Cr_2O_3 and CrO_2 formed on the powder surface during this reaction. This film was calculated to be about 6.7 Å (0.00067 μm) thick. Although the specific surface area of the powder continuously increases, a large proportion of the particles also became welded to each other during the milling process. The welding sandwiched the oxide films between the powder particles. For this reason, the ratio of oxide formed to measured surface (and apparent thickness of the film) increase with ball-milling time. Author

N68-23902# Technisch Documentatie en Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).

TRACKED VEHICLES. AN ANNOTATED BIBLIOGRAPHY UP TO 1967

A. Niermeyer, comp. and B. van Dunne, comp. 1968 41 p refs
(TDCK-49992) CFSTI: HC$3.00/MF$0.65

Presented are 110 abstracts and summaries covering subjects in the following categories: (1) general articles and bibliographies; (2) gas turbines, drives, and transmissions; (3) steering and steering mechanisms; (4) track designs, materials, and comparisons with wheels; (5) trafficability, soil conditions, and vehicle tests; (6) simulation studies; (7) suspension systems; (8) noise measurement; and (9) special-purpose vehicles. K.W.

N68-23963 Pacific Missile Range, Point Mugu, Calif.

A METHOD OF FABRICATING A FORM PLASTIC SHELTER

W. L. Mackie 19 Apr. 1968 14 p
(PMR-TM-68-1; AD-667721)

The report contains a description of the plastic foam shelter designed to meet the need for satellite geophysics observation stations located throughout the world. The shelter was designed for the Pacific Missile Range Satellite Geophysics Office. Shelter materials can be airlifted to the site where the shelter is to be erected. The shelter meets requirements for a structure that can comfortably house men and equipment in polar, tropic, and desert environments. Information is given on necessary materials and procedures to fabricate the shelter. Author (TAB)

N68-23976# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYDROSTATIC EXTRUSION OF CARBON AND GRAPHITE MATERIALS [KONSTRUKTSIONNYE UGLEGRAFITOVYYE MATERIALY SBORNIK TRUDOV]

A. M. Sigarev and Ye. A. Leont'yev 9 Aug. 1967 10 p refs Transl. into ENGLISH of the Publ. "Metallurgiya" Moscow, no. 1, 1964 p 30–33
(FTD-HT-23-633-67; AD-667757)

In the hydrostatic extrusion method, the powder is enclosed in a rubber membrane and compressed in a hydraulic cylinder. According to Pascal's law, all sections on the exterior surface of the rubber bag are under identical pressure. Since in hydrostatic extrusion there is no friction in the outside layers, the rubber membrane is moved together with the particles adhering to it and the given density of the rod is attained at a pressure which is less by 20–30% than in the case of extruding in a mold. This type of rod has a more uniform density distribution throughout the volume than one which is extruded in a mold at the same pressure. It is suggested that this progressive method of extrusion be quickly introduced into industry. Author (TAB)

N68-23983# Royal Aircraft Establishment, Farnborough (England).

THE PREPARATION OF CARBON FIBRE-METAL COMPOSITES AND THEIR FRICTION AND WEAR PROPERTIES

J. P. Giltrow and J. K. Lancaster Oct. 1967 34 p refs
(RAE-TR-67265) CFSTI: HC $3.00/MF $0.65

Composites of randomly oriented, chopped carbon fibers in Pb, Ag, Cu, Ni and Co have been prepared by powder metallurgical techniques, with fibre contents up to 25% by volume. The most satisfactory method of fabrication is hot-pressing of fibres precoated with metal by electrodeless deposition. Rates of wear of the composites, measured at room temperature during sliding against tool steel with and without lubrication, are appreciably lower than those of the parent metals. The coefficients of friction are not reduced, however, nor are the wear rates at elevated temperatures (470°C). It is concluded that the carbon fibers function by facilitating the development of a strengthened surface layer during sliding. The fibers do not appear to improve the bulk mechanical properties and possible reasons for this are discussed. Author (ESRO)

N68-24014# General Electric Co., Schenectady, N. Y. Metallurgy and Ceramics Lab.

IODINE IN LUBRICATION Technical Information Series

R. S. Owens, R. W. Roberts, and E. D. Brown, Jr. (GE—Waterford, N. Y.) Sep. 1967 3 p refs
(Rept.-67-C-350)

A brief survey of studies concerned with the use of iodine in lubrication is presented. Proposed mechanisms, potential problems that may arise with the use of iodine in lubricants, and methods that have been utilized to avoid such problems are described. Author

N68-24112# National Physical Lab., Teddington (England). Aerodynamics Div.

A NOTE ON THE REDUCTION OF THE FLUID-DYNAMIC TORQUE OF BUTTERFLY

D. W. Bryer and D. E. Walshe Sep. 1966 31 p ref
(NPL-AERO-1201) CFSTI: $3.00

Measurements have been made of the aerodynamic torque of butterfly valve discs fitted with fences, and of cambered discs. Flow rates in the duct were also measured. The results are compared with those for a disc of conventional shape and show that for a given overall pressure drop the use of either fences or camber or of a combination of camber and fence, will achieve a reduction of torque; an accompanying loss in maximum flow rate is small, especially for the cambered disc. Author

N68-24142*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FRICTION AND WEAR IN CRYOGENIC LIQUIDS FOR COMPOSITES OF PHENOLIC AND OF POLYTETRAFLUOROETHYLENE OF VARIOUS PARTICLE SIZES AND CONCENTRATIONS

Donald W. Wisander, Lawrence P. Ludwig, and Robert L. Johnson Washington May 1968 17 p refs
(NASA-TN-D-4565) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Experiments conducted with phenolic-PTFE (polytetrafluoroethylene) composites sliding against 440-C steel in liquid nitrogen and in liquid hydrogen showed that lubricating properties of phenolic can be improved by the addition of as little as 15 weight percent of PTFE. Experiments further showed that 15 weight percent PTFE of the 0.2- to 8-micron particle size gave the best results in both liquid nitrogen and in liquid hydrogen. Compressive-modulus and shear-strength tests at room temperature and in liquid nitrogen indicated that these properties were reduced by a factor of 2 to 3 by the addition of 15 weight percent PTFE. Author

N68-24156 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ULTRASONICS IN MACHINE BUILDING

I. G. Khorbenko 8 Sep. 1967 119 p Transl. into ENGLISH from the publ. "Ul'trazvuk v Mashinostroyenii" Moscow, Izd-Vo Mashinostroyeniye, 1966 p 41–67, 79–161
(FTD-HT-23-597-67; AD-667705)

The book presents five applications of ultrasonics in machine building: (1) Ultrasonic machining of hard and brittle materials; ultrasonic machine tools, with several tables listing specific models and their specifications; the industrial application of this type machining for glass, quartz, natural and synthetic gemstones, ferrite, ceramics, porcelain, semiconductor materials, hard alloys, and industrial diamonds; (2) The essentials of ultrasonic soldering and tinning, their industrial applications and certain types of ultrasonic devices; (3) Ultrasonic cleaning methods and several machines for cleaning and degreasing using these methods; (4) Intensification of electrochemical processes, specifically plating processes using copper, nickel, chromium, brass, cadmium, zinc, silver and gold, and applications in metallurgy, which include the crystallization and degasification of aluminum alloys and heat treatment of alloys; polymerization and depolymerization, dispersion, coagulation and production of aerosols, and impregnation; (5) Ultrasonic physicochemical analysis and processes, with examples of ultrasonic level gauges and flowmeters. Author (TAB)

N68-24206# RAND Corp., Santa Monica, Calif.

RELIABILITY ASSESSMENT IN THE PRESENCE OF RELIABILITY GROWTH

A. J. Gross and M. Kamins Sep. 1967 65 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5346-PR; AD-659773)

A methodology is presented for estimating current and future reliability of complex weapon systems that show reliability growth during their development and early operational phases. The study proposes four reliability growth models or patterns that can be fitted to actual data experience to determine the quantitative characteristics of the growth within relatively well-defined tolerances. This is achieved by defining appropriate parametric models and subsequently using maximum likelihood procedures to obtain estimates of the parameters. Comparison of the models shows that under the conditions set forth in this study, three are generally superior in their predictive and assessment characteristics to representative nonparametric methods and to an applicable Bayesian procedure. Author (TAB)

N68-24234 Aerospace Research Labs., Wright-Patterson AFB, Ohio.
MICROSCOPIC PARTICLE SEPARATION AND APPLICATIONS
Robert Poplawski and Roger A. Miller Feb. 1968 80 p refs Presented at the Meeting on Helicopter Propulsion Systems, Ottawa, Canada, 10–14 Jun. 1968
(ARL-68-0024; AD-667557)

The application of ultra-microscopic particle separation studies ranges from the protection of turbine engines from dust and/or sea spray to applications in the field of air pollution. The paper presents not only the theory of these devices and laboratory experimental results, but also field testing results on selected units. The important trade-offs between design parameters and the selection processes required to tailor a dust separator to a specific application are discussed and other important areas of application are suggested. Author (TAB)

N68-24238# Bendix Corp., Southfield, Mich. Research Labs.
FABRICATION OF FLUERIC AMPLIFIERS BY GLASS-DRAWING TECHNIQUES Final Report, Nov. 1965–Sep. 1967
Paul T. Higgins, George W. Goodrich, and Walter F. Datwyler Feb. 1968 65 p
(Contract DA-49-186-AMC-317(D))
(Rept.-4354; AD-667391)

The report covers a novel process for fabricating subminiature flueric elements. In this process the desired fluid element pattern is formed on a relatively large scale from two types of glass having grossly differing solubilities. The resultant composite glass rod is then reduced in cross-section by drawing, the amount of pattern size reduction being proportional to the degree of rod elongation by drawing. Wafers at various thicknesses (representing various desired nozzle aspect ratios) are sliced from the rod. The soluble glass forming the element pattern is then dissolved and the wafers fitted with end covers and fluid connections to provide functional fluidic elements. The practical capabilities of the glass-drawing process were investigated for low-cost fabrication of miniature fluidic elements with various nozzle sizes. Core fabrication by extrusion, combined gross extrusion and machine grind finishing, and machine grinding alone were attempted. In the core ultimately used to fabricate the final elements for inspection and test, an oversized core section was extruded and ground to final shape and dimensions. Starting with an effective element nozzle width of 0.062 inch, a composite rod was drawn to various reduced dimensions. Functional models at the 0.015-inch nozzle size were made up and tested with satisfactory results. Author (TAB)

N68-24291# Naval Research Lab., Washington, D. C.
MANUFACTURE OF THE NRL FILTER UNIT, MODEL A
Benjamin R. Sandoval (San Francisco Bay Naval Shipyard) and Harold F. Bogardus 22 Jan. 1968 47 p refs
(NRL-MR-1852; AD-667713)

The manufacture of the first three production lots of NRL Filter Units, Model A, is described. The fabrication was done at the Mare Island Division of the San Francisco Bay Naval Shipyard with technical assistance by NRL. No serious problems were encountered and the acceptance rate of completed units was above 99 percent. The filter unit is now a standard stock item. Author (TAB)

N68-24312# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Flugtreib- und Schmierstoffe.
INVESTIGATION OF THE FRICTIONAL BEHAVIOR OF SOLID LUBRICANTS IN AIR AND IN HIGH VACUUM [UNTERSUCHUNGEN UEBER DAS REIBUNGSVERHALTEN VON FESTSCHMIERSTOFFEN IN DER ATMOSPHAERE UND IM HOCHVAKUUM]
Guenter Spengler, Willy Hellwig, and Fritz Wunsch Mar. 1968 26 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-18; DVL-721) CFSTI: HC $3.00/MF $0.65

Special problems of lubrication under extreme conditions in aviation and space may often be solved only by the employment of solid lubricants. This paper describes the lubricating behavior of selected solid lubricants in air and in high vacuum, as investigated in plain bearings. The solid lubricant layers are produced on the plain bearing axles and the relation between layer build-up and life of the solid films is investigated. The specially produced MoS_2/PTFE double-layers were found to be the optimum combination at present. The experiments have been made using an especially designed UHV-apparatus to determine sliding, friction and wear characteristics under increased bearing load. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-23096 Stanford Univ., Calif.
MODE COUPLING IN LASERS
Odis Pelham Mc Duff (Ph.D. Thesis) 1966 158 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-4400

Presented is a study of the coupling of the optical modes of a laser by means of an intracavity time varying perturbation. Two methods of perturbation are considered. In the first, termed phase perturbation, an element internal to the laser cavity rapidly varies the effective path length of the optical resonator. In the second, termed loss perturbation, an element internal to the laser cavity rapidly varies the loss of the resonator. A nonlinear analysis of each method of mode coupling, including the effects of atomic lineshape, saturation, and mode pulling as well as the effects of frequency and amplitude of the perturbation is presented. Experimental results are presented for an argon ion laser with an electro-optic modulator as the intracavity loss perturbing element. Qualitatively, the results are found to compare favorably with the theoretical expectations. Dissert. Abstr.

N68-23125# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
LASER SCINTILLATION CAUSED BY TURBULENCE NEAR THE GROUND Research Report, 1 Nov. 1963–30 May 1966
Donald J. Portman, Edward Ryznar, and Arif A. Waqif Hanover, N. H. Cold Reg. Res. and Eng. Lab. Jan. 1968 85 p refs
(Grant DA-AMC-27-021-63-G7)
(CRREL-RR-225; AD-666798)

Laser scintillation was measured for a horizontal optical path 500 m long and 1 m high for various conditions of horizontally homogeneous turbulence. Wind direction, average vertical distributions of wind speed and temperature, and, in some cases, turbulent fluctuations of wind velocity were measured simultaneously. The results of the measurements were analyzed in relation to a set of theoretical relationships derived by Tatarski (1961) for electromagnetic wave propagation in turbulent flow. Tatarskis derivation of the scintillation frequency spectrum (at a point in a plane perpendicular to the optical path) in relation to the three-dimensional spectral density of index of refraction inhomogeneities is summarized and interpreted in relation to its validity for various conditions of turbulence. Analysis of the spectral data showed that their characteristics were similar to Tatarskis theoretical spectrum if the divergence of the laser beam, the size of the receiver aperture, the intensity of scintillation and turbulence spectra were considered. Author (TAB)

N68-23184*# GCA Technology Div., GCA Corp., Bedford, Mass.
STUDY ON THEORY AND APPLICABILITY OF LASER TECHNIQUES FOR MEASURING ATMOSPHERIC PARAMETERS, APPENDIX 1 Quarterly Report
J. Pressman, T. Wentink, and C. Schuler Oct. 1967 24 p refs
(Contract NAS12-540)
(NASA-CR-94513; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20E

This compilation of known Franck–Condon factors and r-centroids tabulates sources of $q_{v'v''}$ and $r_{v'v''}$ matrices. In the tables, references are given to the original arrays for approximately 50 diatomic molecules, for some of their ions or isotopic modifications, and for some 165 separate band systems. The matrix size (extent in maximum v' and v'' covered), its derivation from either Morse or RKR potential assumption, and whether calculation included an equivalent r-centroid array are specified. In general, the largest $q_{v'v''}$ matrix size, especially if accompanied by an $r_{v'v''}$ matrix, is an indication that modern, large computers have been used, thus making it a best choice. Included are 96 bibliographical references typed by an IBM printer directly from IBM cards. K.W.

N68-23359*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTICAL RADAR STUDIES OF THE ATMOSPHERE
J. D. Lawrence, Jr., M. P. McCormick, S. H. Melfi, and D. P. Woodman (Coll. of William and Mary) 19 Apr. 1968 8 p refs Presented at 5th Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 16–19 Apr. 1968
(NASA-TM-X-61083) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Rigorous Mie theory calculations of clear atmosphere volume backscattering cross sections are presented for four laser wavelengths. Ruby laser radar measurements of the atmosphere are compared to a scattering model. In addition, laser radar observations of meteorological phenomena are described. Author

N68-23392*# Yale Univ., New Haven, Conn.
QUANTUM THEORY OF AN OPTICAL MASER. 3: THEORY OF PHOTOELECTRON COUNTING STATISTICS
Willis E. Lamb, Jr. and Marlan O. Scully [1967] 26 p refs Prepared jointly with Mass. Inst. of Tech. Supported in part by AFOSR
(Grant NGR-07-004-035; Contract ARPA SD-90)
(NASA-CR-94546) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Determined are the photoelectron counting statistics produced by the fully quantum mechanical laser considered in a previous paper. The problem of obtaining the photocount distribution from the now known photon statistics is derived in a completely quantum mechanical fashion. The time evolution of the combined photodetector-laser system is derived. The techniques developed for the solution of this problem are of general interest in the area of non-equilibrium quantum statistical dynamics. Author

N68-23525* National Aeronautics and Space Administration, Washington, D. C.
KINETICS OF PHYSICAL PROCESSES IN A CO_2 LASER [KINETIKA FIZICHESKIKH PROTSESSOV OKG NA CO_2]
B. F. Gordiyets, N. N. Sobolev, and L. A. Shelepin May 1968 17 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 53, no. 5, 1967 p 1822–1834
(NASA-TT-F-11667) CFSTI: $3.00 CSCL 20E

A method is developed for calculating the populations of the vibrational levels of a CO_2 laser. The vibrational and the gas temperatures are determined from equations of vibration and heat conductivity energy balance, by introducing the vibrational temperature for each type of vibration. The inverse populations are determined as functions of the relative concentrations of CO_2, N_2, and He, their total pressure, the free electron density, and the discharge tube radius. The effect of these parameters on the laser output power is also estimated. The relations obtained show good qualitative agreement with the experimental curve; they also agree quantitatively within the accuracy of the assumed population model. Author

N68-23570 European Organization for Nuclear Research, Geneva (Switzerland). Proton Synchrotron Machine Div.
DEVELOPMENT OF A LASER-TRIGGERED SPARK GAP
F. Deutsch 28 Dec. 1967 54 p refs
(CERN-67-33)

A delay line was discharged by a spark gap of coaxial design into a terminating resistor. The spark gap was triggered by an axially introduced, focused laser beam; a Q-switched ruby laser giving a pulse of 20 nsec duration and up to 50 MW power was used. The range of operation of the gap, formative time of the breakdown and jitter were investigated for different gases at pressures higher than atmospheric, gap width of 4 to 10 mm and voltages of up to 120 kV. Mixtures of argon and nitrogen were found to have advantages for the foreseen application, such as low threshold for ionization by the laser beam, sufficient dielectric strength, low values of the formative time jitter, and chemical inertness. Formative times of down to about 1 nsec and jitters below 1 nsec were found. The laser power can be relatively low (0.5 to 5 MW). An explanation for the breakdown mechanism is proposed. Author

N68-23912# Perkin-Elmer Corp., Norwalk, Conn.
ACOUSTIC SELF-TRAPPING OF LASER BEAMS Final Report, 1 May 1967–29 Feb. 1968
Edwin L. Kerr 29 Feb. 1968 70 p refs
(Contract N00014-67-C-0468; ARPA Order 306; Proj. Defender)
(Rept.-9204; AD-667475)

Internal filamentary glass damage caused by high power Q-switched pulse lasers and filamentary trapping in liquids is analyzed theoretically in this report. Several models are proposed and discussed for electrostrictively driven acoustic trapping. An analysis of Kerr effect trapping is also given for purposes of comparison. Author (TAB)

N68-24011# Rochester Univ., N. Y. Inst. of Optics.
LOSSES IN RUBY LASERS. THE SPHERICAL-MIRROR FABRY–PEROT INTERFEROMETER Final Report, 1 Apr. 1965–30 Jun. 1967
Michael Hercher and Arthur N. Rosen (Ph.D. Thesis) 20 Dec. 1967 224 p refs
(Contract AF 19(628)-5105)
(AFCRL-68-0061; AD-667561)

A comprehensive study of the losses in ruby lasers is described. The passive losses (unpumped crystal) were studied with a 6328A laser probe and a scanning interferometer. In the optically pumped crystal, the excited-state population was inferred from excited-state absorption at 6328A, and then used to accurately determine active laser losses. For high quality ruby crystals, losses were on the order of 0.03/cm in the passive state, increasing to approximately twice this value when optically pumped. Observed losses at 6328A were in good agreement with calculations based on Mie scattering cross-sections. The excited-state absorption coefficient from the 2E level in ruby at 6943A was found to be 0.0 plus or minus 0.05/cm. Losses due to thermal distortion of the ruby rod were found to be negligible during pulsed operation of the laser. An appendix to this report gives a detailed description of the spherical-mirror Fabry-Perot interferometer, and specific interferometer designs are discussed. Author (TAB)

N68-24329# Massachusetts Inst. of Tech., Cambridge.
STUDY OF VARIOUS ASPECTS OF RAMAN SCATTERING USING GAS LASERS Semiannual Technical Summary Report, 1 Feb.–31 Jul. 1967
15 Apr. 1968 28 p refs
(Contract Nonr-3963(22); ARPA Order 306; Proj. Defender)
(SATR-4; AD-667742)

The laser induced line narrowing effect, observed and utilized previously in precise isotope shift determination in Ne, is analyzed theoretically in considerable detail. It is shown that two types of multiple quantum processes play important roles and dramatically influence the lineshape of the laser-induced signal. This line narrowing effect is particularly useful in precise measurements of atomic energy level structure; it also involves novel radiative processes influencing dramatically the observed shapes. An experiment is in progress in which a new gas laser mechanism is being explored as a possible mechanism in a previously observed laser oscillation in one of the visible Ne transitions and also in a similar laser transition in Argon. Furthermore, this effect is also being explored to obtain possible laser oscillation in a number of important atomic transitions, such as the hydrogen H alpha line. The experiment on the motional narrowing of the spontaneous Raman scattering in hydrogen molecule is being pursued actively. Several new laser designs were constructed and tested. TAB

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-23060 Lehigh Univ., Bethelehem, Pa.
EFFECTS OF ORIENTATION AND DOMAIN CONFIGURATION ON THE MAGNETOSTRICTION OF SUPERMENDUR
Charles Eugene Houck (Ph.D. Thesis) 1966 93 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-4868

Polycrystalline Supermendur sheet, 49 wt.% Fe-49 wt.% Co-2 wt.% V, was subjected to cold rolling, annealing, and magnetic annealing. The effects of these mechanical, thermal, and magnetic treatments on the preferred orientation and the magnetostriction of the alloy were determined. The application of a magnetic field during annealing resulted in a slightly lower texture intensity but had no significant effect on the character of the texture obtained. The observed magnetostriction values were influenced by the rolling and annealing textures present in the material. This appeared to be due primarily to a crystalline magnetic anisotropy effect. Magnetic annealing had a marked effect on the magnetostriction of Supermendur for all magnetic anneals performed. The effect of texture and magnetic annealing variables, i.e., annealing temperature, magnetic field, and furnace atmosphere, on the response of the alloy to magnetic annealing was discussed. Dissert. Abstr.

N68-23142# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
DESIGNATION OF ALLOYS FOR THE AEROSPACE INDUSTRY (REVISED)
W. D. Penniman 1 Feb. 1968 58 p
(Contract F33615-68-C-1325)
(DMIC-MEMO-232; AD-666682)

This document presents a computer-generated listing of principal alloys of interest in defense work. Included in the listing are alloy designations, specifications, and nominal compositions. Because the report is machine generated, it is intended to be updated frequently in order to keep up with new alloys and specifications. This Memorandum updates DMIC Memorandum 223, which was published April 12, 1967. Author (TAB)

N68-23161 Northwestern Univ., Evanston, Ill.
THE EFFECTS OF STRUCTURE UPON THE MECHANICAL BEHAVIOR OF β–NiAl
Eugene Paul Lautenschlager, Jr. (Ph.D. Thesis) 1966 326 p
Available from Univ. Microfilms: HC $14.85/MF $4.20 Order 67-4243

An investigation was conducted over the entire solid solubility range of intermetallic β–NiAl by means of X-ray diffraction, compression of polycrystalline specimens, appropriate hard sphere models, and electron microscopy in order to study the effects of structure (i.e., long-range order, point defect concentration and distribution, and atom displacement) upon the mechanical behavior. Dissert. Abstr.

N68-23162 Lehigh Univ., Bethlehem, Pa.
IMPURITY EFFECTS IN IRON BASE WELD METAL
Richard Allen Moll (Ph.D. Thesis) 1966 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4874

A study was made of the effects of composition, especially impurities, on the notch toughness and tensile properties of high purity iron weld metal. The behavior of pure iron was first determined followed by a series of carbon and carbon plus manganese alloys. An Fe–C–Mn base was selected and P, S, Si, and Al added, both separately and combined, until the composition of a mild steel weld metal was approximately duplicated. The properties of a commercial mild steel weld metal were then determined and compared with those of the synthesized alloy. Weld metal wire was fabricated by the swaging of bars cut from vacuum melted ingots. The effects of composition on tensile properties showed the following trends - C, Mn, P, S, Si, and Al progressively increased the yield and tensile strength and had little effect on the ductility of iron base weld metal. The yield ratio was lowered by C, raised by P, S, Si, and Al, and unaffected by manganese. Dissert. Abstr.

N68-23166# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
INDEX OF TEMPER DESIGNATIONS OF ALLOYS
W. D. Penniman 1 Feb. 1968 15 p
(Contract F33615-68-C-1325)
(DMIC-MEMO-233; AD-666681)

The memorandum presents the definitions of temper designations. It is organized into three parts: (1) temper designation (alphanumeric), (2) temper, by metallurgical term, (3) tempers by base material. This memorandum, in conjunction with Memorandum 232, Designations of Alloys for the Aerospace Industry provide a ready reference for any given combination of alloy and temper designations. Author (TAB)

N68-23168# Texas Univ., Austin. Engineering Mechanics Research Lab.
THE EFFECT OF VACUUM ON SURFACE DAMAGE IN FATIGUE Final Scientific Report
M. A. Wilkov and B. Applewhite Dec. 1967 29 p refs
(Grant AF-AFOSR-560-66)
(EMRL-RM-1039; AFOSR-67-2399; AD-666678)

The environment at the surface is known to have a marked effect on the fatigue behavior of metals. In spite of considerable work on the relation between fatigue and environment almost

nothing is known with certainty about the surface morphology and surface condition near the damage zones. The changes in both the surface topography and the dislocation structure, produced during fatiguing aluminum crystals in vacuum were investigated using electron microscopy and surface nucleation. It was found that the intrusions formed faster during fatigue in vacuum than in air, however, the width of the damage zone was reduced. The observation of enhanced nucleation on the slip lines in both specimens fatigued in vacuum exposed to air and then deposited and specimen fatigued in vacuum and deposited immediately indicated that the biggest difference in the surface damage was morphology rather than the condition of the oxide layer. Author (TAB)

N68-23247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE LESS COMMON REFRACTORY METALS: (RHENIUM, HAFNIUM, TECHNETIUM, NOBLE METALS)
Joseph Maltz [1967] 34 p refs Presented at the AIME Symp. on the Met. and Technol. of Refractory Metal Alloys, Washington, D. C., 25–26 Apr. 1968
(NASA-TM-X-61073) CFSTI: $3.00 CSCL 11F

Previous reviews of the less-common refractory metals are cited and supplemented with discussions of newer developments. Special attention is given to the roles of hafnium–tantalum alloys and of iridium as oxidation-resistant coatings suitable for special situations. The physical metallurgy of technetium, which has only recently become available in sufficient amount for studies of that type, is another subject of attention. New data on phase equilibria, mechanical and physical properties, and availability are included. Insofar as the potential usage of these metals in applications which depend upon their high melting point is concerned, high cost and low availability preclude any radical changes in the near future. Instead, an orderly growth is indicated as research pinpoints the occasional unique benefits which can justify their very high cost. Author

N68-23252# ManLabs, Inc., Cambridge, Mass.
CALCULATION OF REGULAR SOLUTION PHASE DIAGRAMS FOR TITANIUM BASE BINARY SYSTEMS
Larry Kaufman and Harold Bernstein Apr. 1968 20 p refs Presented at the AIME Intern. Conf. on Titanium, London, 21–24 May 1968
(Contract Nonr-2600(00))
(TR-14; AD-666966)

Previously developed computer techniques for calculating phase equilibria between regular solution phases and line compound-regular solution equilibria have been employed to compute binary phase diagrams for twenty titanium base systems including most of the transition metals and aluminum. Comparison with experimentally observed diagrams yields satisfactory agreement. The description includes the activity of each component as well as the heat of formation of compound phases. Extension of this method to ternary and higher order systems should offer substantial advantages in application and development of advanced alloys and composite materials. Author (TAB)

N68-23312# Sheffield Univ. (England). Dept. of Physics.
ELECTRONIC STRUCTURE OF METALLIC ALLOYS Quarterly Status Report, 1 Sep.–30 Nov. 1967
N. H. March and J. S. Rousseau 30 Nov. 1967 6 p ref
(Contract DAJA37-67-C-0474)
(QSR-3; AD-665818)

In a previous report a method using the effective potential matrix (Hilton, March and Curtis, 1967 referred to hereafter as HMC) was proposed for dealing with alloys. In order to apply this method to either solid or liquid alloys, configuration averages have to be performed. The main task in this reporting period has been a study on averaging over random arrays. A pseudoatom, as discussed by HMC has been considered. The density matrix for a random array of such pseudoatoms is discussed. It is shown how such random averaging can be carried out in the approximation of independent pseudoatoms. Finally the necessary modifications for binary alloys is indicated. (TAB)

N68-23363# Technische Hochschule in Wien (Austria). Institut fuer Angewandte Physik.
MAGNETIC TRANSITION METAL. RARE EARTH ALLOYS Final Report
Franz Lihl 27 Oct. 1967 36 p refs
(Contract AF 61(052)-942)
(AD-666993)

The present state of the preparation of YCo5 and other RECo5 compounds by means of the amalgam process is reviewed. These compounds are interesting for powder permanent magnets. By an ultrasonic treatment of Y-Co-amalgam, followed by a heat treatment up to 1200C, finely divided YCo5 particles can be obtained, which seem to be well suited for permanent magnets. The system Nd-Mn has been investigated by X-ray diffraction, X-ray fluorescence DTA and micrographs. The intermetallic compounds Nd6Mn23 and NdMn12 are present. A schematic phase diagram is presented. Magnetic measurements on these compounds are given. Nd6Mn23 is ferromagnetic, NdMn12 seems to be antiferromagnetic at low temperatures. The system Tb-Mn has also been investigated and a schematic phase diagram is given. The compounds TbMn2, Tb6Mn23 and TbMn12 are present. Their crystal structure and lattice spacings are given. The phase diagrams of Tb-Hg and Yb-Hg have been investigated by differential thermal analysis. The schematic phase diagrams are presented. These diagrams are the basis for investigations of Tb- and Yb-alloys by means of the amalgam process. Author (TAB)

N68-23419# Union Carbide Nuclear Co., Oak Ridge, Tenn.
DETERMINATION OF SELECTED MECHANICAL AND PHYSICAL PROPERTIES OF CAST VERY-HIGH-ASSAY URANIUM
D. J. Legacy and W. J. Yaggi 29 Jan. 1968 21 p
(Contract W-7405-ENG-26)
(Y-1593)

Mechanical and physical tests were performed on very-high-assay (97.5% ^{235}U) uranium castings. The castings were sampled at locations selected to determine any edge-to-center or top-to-bottom variation in properties. The test results, subjected to statistical analysis, indicated that the properties were uniform within each casting and among castings. Author (NSA)

N68-23424# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
FRACTURE MECHANICS EVALUATION OF REACTOR VESSEL STEELS Quarterly Progress Report, Period Ending 31 Dec. 1967
Jan. 1968 18 p refs
(Contract AT(30-1)-3677)
(WCAP-3677-6; EURAEC-1953) CFSTI: HC$3.00/MF$0.65

The experimental program for the development and evaluation of a fracture mechanics approach to the problem of brittle fracture of reactor vessel materials, based upon the use of modified Wedge Opening Loading (WOL) specimens, is described. The testing applies to both irradiated and unirradiated specimens. Materials being tested include base metal samples from two different heats of a Ni modified, Mn–Mo steel and a European forging grade material; and weld and heat affected zone samples from one of a Ni modified, Mn–Mo steel. Tensile, Charpy V-notch and drop weight specimens from those materials are included. Author (NSA)

N68-23437*# American Optical Co., Pittsburgh, Pa. Space Defense Div.
A STUDY OF THE USE OF VARIOUS METALS FOR OPTICAL REFLECTING ELEMENTS Final Report

[1967] 37 p
(Contract NAS5-9631)
(NASA-CR-94577; FR-2259) CFSTI: HC $3.00/MF $0.65 CSCL 11F

This report is a study concerning the use of four aluminum alloys, nickel, beryllium, and Haynes 25 as uncoated optical reflecting elements. Beryllium, nickel, and Haynes 25 were successfully optically polished and figured to $\lambda/4$ and their time, temperature, and stress stability were determined. None of the three aluminums could be optically polished and figured. Author

N68-23458*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report, 21 Oct. 1967–21 Jan. 1968
J. Rexer [1967] 9 p refs
(Contract NASw-1405)
(NASA-CR-94568; PR-7) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The objectives of the work were: (1) to measure the change in thickness of an iridium coating on the refractory metals tungsten, molybdenum, and niobium annealed at several temperatures for various times; and (2) to examine the mechanical behavior of iridium-coated and heat-treated specimens with a microbend tester. Two molybdenum–iridium diffusion couples previously hot-pressed were sectioned and microscopically examined for intermetallic compound formation. A strip from each hot-pressed couple was bent in flexure to determine bending strength of the composites and of heat-treated, uncoated, molybdenum. Cracks initiated in the composite during bending at the outer iridium surface and propagated through the iridium towards the molybdenum–iridium interface. Additional sections of the hot-pressed couples were metallographically polished on one surface, and the thickness of the iridium coating measured microscopically. The specimens were then annealed and remeasured for loss of iridium as a function of time and temperature. Author

N68-23469*# City Coll. Research Foundation, New York.
FUNDAMENTALS OF THE OXIDATION PROTECTION OF COLUMBIUM AND TANTALUM Semiannual Report, Oct. 1, 1967–Apr. 1, 1968
M. Kolodney and R. A. Graff 1 Apr. 1968 31 p refs
(Grant NGR-33-013-013)
(NASA-CR-94582; SAR-5) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An investigation of the fundamental processes involved in the protection of tantalum and columbium by their silicides is in progress. The first part is devoted to establishing thermochemical data for the silicides and employs an entirely solid state electrochemical cell. The second part deals with the protection of both coating and substrate by the protective glass formed during oxidation. In the third part oxidation rates and the possibility of using coating modifiers to promote the formation of glassy films is tested. The formation of intermediate phases between the silicide and the substrate are being investigated in the fourth part of the program along with the efficacy of diffusion barriers to retard intermediate phase growth. Preliminary results on the rate of oxidation of $TiSi_2$ between 300 and 1200°C are presented. New information on interphase growth in the $Ta–TaSi_2$ system has been obtained. A new line of investigation on silicide reactions has been added. Author

N68-23499# Army Materials and Mechanics Research Center, Watertown, Mass.
SHEET TENSILE PROPERTIES OF TITANIUM ALLOYS AS AFFECTED BY TEXTURE
Anthone Zarkades and Frank R. Larson Jan. 1968 41 p refs
(AMMRC-TR-68-03; AD-666765)

A study was carried out on the effect of specimen orientation on the sheet tensile properties of several titanium alloys. For these alloys, chemical analysis, microstructure, X-ray pole figures, and sheet tensile properties were determined at 10-degree increments from the rolling to the transverse direction. In addition to the conventional yield strength, tensile strength, and elongation values, strain gages were used to determine Youngs modulus and Poissons ratio. A study of plastic anisotropy was also made. It is shown that several types of textures exist in these alloys and the characteristics of the mechanical properties are anisotropic and related to the texture type. A simple approximation of the anisotropic behavior patterns can be understood by relating these patterns to single-crystal properties. Author (TAB)

N68-23560*# Boeing Co., Seattle Wash.
ULTRAVIOLET-PROTON RADIATION EFFECTS ON SOLAR CONCENTRATOR REFLECTIVE SURFACES Final Report, Jun. 1965–Aug. 1967
R. B. Gillette Washington NASA May 1968 146 p refs
(Contract NAS1-5251)
(NASA-CR-1024) CFSTI: HC $3.00/MF $0.65 CSCL 11D

The effects of proton and ultraviolet radiation on the specular and diffuse reflectance of stretch-formed aluminum, electroformed nickel and magnesium substrate solar mirrors were studied in high vacuum at temperatures from −195° to 200° and energies from 2 to 30 keV. Ultraviolet exposures were vacuum deposited Al, which in some cases were overcoated with Si_2O_3 or SiO_2. The most severe mechanism of radiation-induced degradation was found to be proton blistering. Author

N68-23591*# National Aeronautics and Space Administration, Washington, D. C.
STRUCTURAL CHANGES IN CHROMIUM DURING DEFORMATION [STRUKTURNYYE IZMENENIYA V KHROME PRI DEFORMATSII]
V. A. Manilov, V. G. Tkachenko, V. I. Trefilov, and S. A. Firstov May 1968 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR. Metally (Moscow), no. 2, 1967 p 114–121
(NASA-TT-F-11652) CFSTI: HC $3.00/MF $0.65 CSCL 11F

In view of the high brittleness of metals with a body centered cubic lattice, considering the essential structural sensitivity of the temperature in transition to a brittle state, a study was made to determine the relationship of changes in the temperature of cold brittleness with structural changes accompanying preliminary deformation. Analyzed are results of electron microscopic studies of structural changes in chromium at high temperatures and relatively low speeds of deformation; and at low temperatures and relatively high speeds of deformation. Results of studies of structural changes during annealing, and after thermal lamination are also included. S.C.W.

N68-23642*# TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.
GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Monthly Report, 17 Mar.–14 Dec. 1967
K. D. Sheffler and E. A. Steigerwald 14 Dec. 1967 243 p refs
(Contract NAS3-9439)
(NASA-CR-72391; MR-9) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Molybdenum-base TZC and TZM alloys and tantalum-base T-111 and Astar 811C are creep tested in a vacuum environment. Test temperatures range from 1600 to 2600°F and stresses from 0.5 to 65 Ksi. Test parameters have been selected to provide 0.5–1.0% creep in 5000 to 15,000 hours. Test results with molybdenum-base TZC and TZM show the effects of variations in composition and thermal-mechanical processing history on 1/2% creep life. Analysis of these data using the Larson–Miller parameter indicates that at higher stress levels and lower temperatures a specially processed lot of TZM having a somewhat higher than normal carbon content is superior to TZC in the stress relieved condition, whereas at higher temperatures and lower stresses, the

behavior of the two materials is comparable. A Larson–Miller plot for 1% creep of commercial purity tantalum tubing has been constructed based upon extrapolation of five short term creep tests performed sequentially upon two specimens shows a very sharp change in the creep resistance of the pure tantalum between 1183°F and 1350°F. Tests designed to evaluate the creep behavior of T-111 subjected to continuously increasing loads exhibit progressively increasing creep rates. The experimental techniques involved in these tests and various methods for prediction of continuous load life from static creep test data are discussed. Author

N68-23681# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

CURRENT DEVELOPMENTS IN FIBER-REINFORCED COMPOSITES Technical Report, Jan.–May 1967

James A. Snide, C. T. Lynch, and L. D. Whipple Feb. 1968 83 p refs

(AFML-TR-67-359; AD-667527)

A review of recent progress in composite technology is presented with primary emphasis on fiber-reinforced metal-matrix composites. A brief discussion of the development of high strength, high modulus, low density filaments is included. Current efforts on plastic and ceramic matrix composites is considered for comparative purposes. Filament-matrix compatibility is identified as the major limiting factor in high temperature fabrication and utilization of metal-matrix composites. Some approaches to the solution of this compatibility problem are discussed. The various fabrication methods are reviewed and the mechanical behavior of metal-matrix composites is illustrated with a boron-reinforced aluminum system. The method taken to expedite the development of advanced composites as practical engineering structures is discussed. This approach has been to integrate the efforts of materials engineers, designers, and fabricators into a single team. This team concept is illustrated by showing the progress of the development of fiber-reinforced plastic aerospace structures. Fabrication requirements show a definite need for automated tape layup techniques. Current program efforts indicate that theoretically weight can be reduced by using composite structures. Sometimes in practical applications even greater weight savings can be realized. Author (TAB)

N68-23697# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

THE MECHANICAL PROPERTIES OF HYDROGENATED ZIRCALOY-2 CONTAINING SELENIUM ADDITIONS

G. P. Walters Dec. 1967 11 p refs

(AERE-R-5639) HMSO: 3s

The effect of selenium and hydrogen on the tensile properties of zirconium and zircaloy-2 has been studied. In both materials selenium and hydrogen have little effect on the 0.1% proof stress and ultimate tensile strength; they do however reduce ductility quite markedly. Optical metallography revealed hydride platelets in the grain boundaries, the precipitation characteristics being uninfluenced by the presence of selenium. Unhydrided specimens fractured along grain boundaries containing selenium; when hydrogen was present fracture occurred along boundaries containing hydride platelets. The zirconium/selenium alloys are expected to be susceptible to hydride stress re-orientation, and hence anistropic ductility, in a similar manner to the conventional zirconium alloys used in water reactor systems. Author

N68-23728# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

EFFECT OF pH ON THE WEAR CHARACTERISTICS IN WATER OF TEN METAL COMBINATIONS

O. Ogunlade Oct. 1967 37 p refs

(AECL-2784) CFSTI: HC $3.00/MF $0.65

The room temperature wear characteristics of ten journal sleeve metal combinations were investigated in pH 10 water and compared with results in pH 7 water. The ten combinations were randomly selected from those which had been tested successfully for at least two million inches of travel under laboratory conditions. The results of tests in pH 10 water were similar to the results of tests in pH 7 water. Author (NSA)

N68-23769# Brown Univ., Providence, R. I. Div. of Engineering.

A COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE MECHANICAL PROPERTIES OF METALS Technical Progress Report, Feb. 1967–Jan. 1968

D. C. Drucker, J. Gurland, R. W. Armstrong, J. Rice, and M. H. Richman Jan. 1968 10 p

(Contract AT(30-1)-2394)

(NYO-2394-31) CFSTI: HC $3.00/MF $0.65

The strength and fracture of spheroidized carbon steel regarded as a model for one type of z-phase alloy was studied. The hardness–grain size relation of brass was correlated with the Hall–Petch stress–grain size parameters. Work continued on the mechanism of particle strengthening in cast Al–Si alloys, on the fracture mechanism of Co–WC alloys, and on plastic deformation accompanying a cleavage crack in zinc. Macroscopic fundamentals in brittle fractures, and the role of voids in ductile fracture studies are being continued. NSA

N68-23825# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DENSITY AND MOLAR VOLUME OF COPPER AND COPPER–LEAD MATTES [PLOTNOST' I MOLYARNYY OB'YEM MEDNYKH I MEDNOSVINTSOVYKH SHTEYNOV]

V. P. Bystrov, A. V. Vanyukov, and V. Ya. Zaitsev *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 79–84 refs (See N68-23814 13-15)

The method adapted for the determination of density in melts which contain a component with high vapor pressure (PbS) proved to be reliable. For the first time the density of the molten sulfides containing Pb was determined for a wide range of composition and temperature. The results obtained are valuable for application in equations presenting physicochemical properties of mattes. The calculated values for molar volume of Cu and Cu–Pb mattes provide supplementary data concerning the participation of individual components in the constitution of sulfide matte. Author

N68-23826# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF CALCULATING THERMODYNAMIC PROPERTIES OF BINARY SOLUTIONS ON A NICKEL BASE [METOD RASCHETA TERMODINAMICHESKIKH SVOYSTV BINARNYKH RASTVOROV NA OSNOVE NIKELYA]

B. P. Burylev *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 85–95 refs (See N68-23814 13-15)

Formulas are presented for the different types of deviations from the laws of ideal solutions, showing the relation between the activity coefficients of the components and the components of the solution and the temperature. The formulas were checked on experimental data obtained by other investigators for binary alloys of various components with Ni. Author

N68-23829# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF THE MATERIAL COMPOSITION OF LEAD BATCHES ON THEIR PELLETIZING [VLIYANII VESHCHESTVENNOGO SOSTAVA SVINTSOVYKH SHIKHT NA IKH OKATYVANIYE]

V. P. Ryazanov and A. Ye. Guriyev *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 109–114 refs (See N68-23814 13-15)

Further study is devoted to the recent widely accepted method of preparing lead-containing batch sintering. The method consists in mixing 36F15 in the moist state with subsequent pelletizing. The general regularities of the mixing and pelletizing of typical lead batches were studied by laboratory experiment. The physical properties of the pellets were determined by the standard methods, with small charges in the resistance to dropping and impact. The number of completely preserved pellets determined the resistance to dropping and impact. A determination was also made of the temperature up to which pellets are not destroyed during fast heating. Results of experiment showed that: (1) An increase of return dust in a lead charge to 5% enlarges pellets without lowering their physical properties. (2) The introduction into the lead charge of up to 5% granulated slag somewhat enlarges the pellets. (3) An increase in the content of sulfate lead cake in a pelletizing charge to 10% and more with a simultaneous increase of the initial moisture content (to 6.4–7%) leads to enlargement of pellets and consequently to an increase in the productivity of the granulator. Author

N68-23837# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF HYDROGEN ON THE MECHANICAL PROPERTIES OF TITANIUM AND THE ALLOY OT4-1 [VLIYANIYE VODORODA NA MEKHANICHESKIYE SVOYSTVA TITANA I SPLAVA OT4-1]
V. A. Livanov, A. A. Bukhanova, B. A. Kolachev, N. P. Neverovaskobeleva, I. I. Slavina et al. *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 159–165 refs (See N68-23814 13-15)

The aim of this work was to study the influence of hydrogen on the mechanical properties of OT4-1 alloy, particularly on the impact strength, and to establish the maximum permissible hydrogen content at which the high resistance of the metal to brittle failure is still retained. For comparison, identical tests were carried out on technical-grade titanium, brand VT1-1. It was found that of all the properties studied, the impact strength of VT1-1 and OT4-1 was the most sensitive to changes in hydrogen content. The lower this content, the lesser the tendency of the titanium alloys toward brittle failure. The authors were unable to establish the maximum permissible hydrogen content and indicate the need for further investigations in this direction. Heating of OT-4 to 900°C followed by cooling in air or in water reduces the adverse effect of hydrogen on the impact strength (at the hydrogen contents studied, i.e., up to 0.01%). However, additional experiments are needed for a better understanding of the stability of the properties obtained during the heat treatment and in the course of natural and artificial aging. Author

N68-23865 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A STUDY IN METALLOGRAPHY HARDNESS AND STRUCTURAL ROENTGENOGRAPHY OF POWDER METALLURGY NB 25–30 SN ALLOYS AFTER HEAT TREATMENT [BADANIA METALOGRAFICZNE, TWARDOSCI I RENTGENOGRAFICZNE STOPU O SKLADZIE NB-25–30% SN, PO OBROBCE CIEPLNEJ OTRZYMANEGO NA DRODZE METALURGII PROSZKOW]
W. Rutkowski and Z. Horubala 1967 20 p refs In POLISH; ENGLISH summary
(IBJ-871/XIV/PS) CFSTI: $3.00

Nb–Sn alloy specimens containing Nb_3Sn and Nb phases were investigated after heat treatment. Melting and preparation of the samples, X ray analysis, microhardness tests, and metallographic examinations are briefly discussed. The Nb_3Sn phase was found to be stable in the temperature range from 20° to 1100°C. The results are compared with those obtained by other authors. K.W.

N68-23886# Virginia Inst. for Scientific Research, Richmond.
THE MECHANICAL PROPERTIES OF THE CORROSION PRODUCT FORMED DURING OXIDATION OF COPPER Final Report, 1 Apr. 1966–31 Mar. 1968
Billy W. Sloope 2 Apr. 1968 58 p refs
(Contract N00014-66-C-0182)
(AD-667491)

The mechanical properties of copper and oxidized copper films were measured using the bulge technique. The mechanical strength (rupture) was found to increase with decreasing thickness with a significant increase occurring below 1000 A. Youngs Modulus is independent of thickness over the 700-4500 A thickness range. Copper films were oxidized in air at 150C for times from 15 min to 72 hrs. Comparison of these results indicate that the mechanical properties observed are due to the remaining underlying copper film. Author (TAB)

N68-23923*# General Dynamics/Convair, San Diego, Calif.
WELDMENT FLAW GROWTH CHARACTERISTICS OF 2219-T81 ALUMINUM ALLOY Final Report
W. E. Witzell and C. J. Kropp Sep. 1967 138 p refs
(Contract NAS3-7951)
(NASA-CR-72288; GD/C-DBG-67-002) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A literature search and industry survey were performed and reported. The plate and sheet were welded using automatic GTA (gas–tungsten-arc, sometimes called TIG) weld techniques and manual repair weld techniques. The fracture characteristics were studied at room temperature, −320 and −423°F by locating notches and cracks in the parent material, heat-affected zone, fusion line, and the center of the weld metal. Mechanical properties of the various zones were obtained by tensile tests utilizing small strain gages. Welding causes a large reduction in yield strength for 2219-T81 sheet and plate but only a modest reduction in ultimate strength. In general, the static toughness properties of the base material sheet and plate increase with a reduction in temperature. However, the toughness in the center of the weld shows a significant decrease between −320° and −423°F in both plate and sheet. The cyclic crack or flow growth for 2219-T81 is somewhat erratic for automatic welded material and is very erratic for repair welded material. Author

N68-24002# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
STANDARD DATA FOR USE IN THE INTERPRETATION OF DIFFRACTION CONTRAST EFFECTS FROM FACE CENTRED CUBIC METALS
M. M. Hutchison May 1966 42 p refs
(ARL/MET/58) CFSTI: HC $3.00/MF $0.65

A set of standard diffraction patterns for the face centred cubic lattice is presented and a method described which may be used for the rapid identification of unknown diffraction patterns from metal foils. Thirteen theoretical pictures have been constructed using the projected widths of the regions of the foil which are intersected by the various {111} planes, and the angle between these projections. The comparison of the theoretical picture with the electron micrograph can be of considerable assistance in the interpretation of the various features. The theoretical pictures also include the directions (as seen in projections for the particular orientation) of the lines of intersection of the various {111} planes. In addition, easily consulted data are given which are a guide to the conditions under which the various types of dislocations will be invisible. Author

N68-24015# Atomic Energy Commission Research Establishment, Riso (Denmark). Metallurgy Dept.
DISPERSION-STRENGTHENED MATERIALS, 1965 BIBLIOGRAPHY (SUPPLEMENT 3)

Hans Lilholt, J. C. Balling Jensen, and Ulla Jensen Aug. 1968 88 p refs
(RISO-48, Sup. 3)

The annotated bibliography consists of 445 references to available literature on dispersion-strengthened materials and related problems, covering the year 1965. Author (NSA)

N68-24065# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF HYDROGEN IN ALUMINUM ALLOYS BY THE METHOD OF ISOTOPIC BALANCING [OPREDELENIYE YODORODA V ALYUMINYEVYKH SPLAVAKH METODOM IZOTOPICHESKOGO URAVNOVESHIVANIYA]
N. M. Orlova and A. A. Petrov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 81–88 refs (See N68-23058 13-06)

A spectral isotopic method for the determination of hydrogen in aluminum and in some of its alloys has been developed. Both cast aluminum alloys and pressure-worked specimens were studied. The isotopic equilibrium was carried out on cylindrical specimens 5–6 mm in diameter, weighing 10–20 grams at 500°C temperatures (much lower than melting point of aluminum), with experimental errors in hydrogen volume determination of the order of 0.05+0.01 cm^3. The isotopic equilibrium duration in Mg, Mn, and Cu alloys was 25–30 min. The type of treatment previously used on the specimen showed no observable effect on the isotopic exchange. The residual hydrogen content measured for the various aluminum alloys was 0.1–0.2 cm^3/100 gm. This method enables one to determine separately the gas content in the surface layer as well as in the bulk of the aluminum specimen. Because of hygroscopic films observed on the aluminum and the absorption of water vapor, some of the aspects of the sorption and the desorption of hydrogen in the surface oxide layer were also studied. Author

N68-24111*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CREEP OF TANTALUM T-222 ALLOY IN ULTRAHIGH VACUUM FOR TIMES UP TO 10,000 HOURS
Robert H. Titran Washington May 1968 18 p refs
(NASA-TN-D-4605) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The long time creep behavior of fine-grained (0.016-mm) Ta-9.11W-1.91Hf-0.01C was determined over the temperature range of 2000° to 2600°F (1093° to 1426°C) and in a vacuum of 10^{-8} torr (1.33×10^{-6} N/cm^2). Creep stresses ranged from 2500 to 20,000 psi (17.5×10^6 to 138×10^6 N/m^2) for test times up to 10,000 hours. At temperatures ranging from 2000° to 2600°F (1093° to 1426°C), stress levels to limit creep to 1 percent in 10,000 hours are 28,000 and 800 psi (193×10^6 and 6×10^6 N/m^2), respectively. The stress dependence of the steady creep rate was 3, and the temperature dependence of steady creep was equivalent to an apparent activation energy of 150 kcal/g-mole (627 450 J/g-mole). Author

N68-24124*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIBER REINFORCED METAL COMPOSITES UNDER STUDY AT LEWIS RESEARCH CENTER
J. W. Weeton and R. A. Signorelli Washington 1968 31 p refs Presented at 14th Refractory Composite Working Group Meeting, AF Mater. Lab., Wright-Patterson AFB, Ohio, 6–22 May 1968
(NASA-TM-X-52444) CFSTI: HC$3.00/MF$0.65 CSCL 11D

Summary information is given on work being conducted in the area of fiber reinforced metal composites. Equations are given for deriving the strengthening mechanisms associated with fiber reinforced metallic materials. A copper model system was used to assess two important factors influencing the strength of composites, the length-to-diameter ratio, and fiber orientation. The creep-failure or strengthening mechanisms of composites is discussed along with the effect of interfiber distance and temperature on critical aspect ratio in composites. Fiber reinforced composites that can be tailored to do different jobs are considered, and composite materials with very high stress rupture strength are examined. The use of ceramic whiskers and polycrystalline ceramic fibers as strengthening mechanisms is also evaluated. B.S.D.

N68-24148 New York Univ., N. Y. Research Div.
DEVELOPMENT OF TOUGH HIGH-STRENGTH ALPHA BETA TITANIUM-BASE ALLOYS AT 240,000–260,000 PSI YIELD STRENGTH LEVEL Final Report, 25 Jun. 1962–30 Apr. 1966
P. A. Farrar and H. Margolin Watertown, Mass. Army Mater. and Mech. Res. Center Sep. 1967 345 p refs
(Contract DA-30-069-ORD-3690)
(WAL-TR-401/303-13; AD-667379)

In order to develop titanium alloys with higher ductilities and 0.1% yield strengths in the range of 190,000 to 240,000 psi and usable ductility in the range from 240,000 to 260,000 psi, a total of 57 eight-pound and 2 ten-pound ingots were investigated. Eight alloys which showed promising properties in the 190,000-240,000 psi range as 8 lb. ingots were remelted as 80 lb. ingots for further evaluation as bar, plate and sheet material. Tensile tests at room temperature and -40F impact tests were performed on the bar stock and the plate for the eight ingots. In addition, elevated and low temperature impact, as well as smooth and notch bar tests, were performed on the 1/2 inch bar for the most promising heat treatments. The sheet material was tested at room temperature with the most promising heat treatments being tested at -320F, +400F, +600F, with some of the alloys being tested at +800F and 1000F as well. In addition, limited welding tests were run on the sheet. Author (TAB)

N68-24149# Alabama Univ., University. Bureau of Engineering Research.
HIGH TEMPERATURE X-RAY DIFFRACTION INVESTIGATION OF THE TiNi INTERMETALLIC COMPOUND Final Report
15 Mar. 1968 37 p refs
(Contract DAAH01-67-C-1474)
(AD-667398)

At an elevated temperature of 1000 degrees C the TiNi intermetallic exists as ordered cesium chloride-B2 type lattice. The ordered structure may be stable or metastable depending upon cooling rate to room temperature. The ordered and disordered structures appear to co-exist. Author (TAB)

N68-24167# Joint Publications Research Service, Washington, D. C.
CERMETS IN ATOMIC TECHNOLOGY
G. A. Meyerson 13 May 1968 31 p refs Transl. into ENGLISH from Poroshkovaya Met. (USSR), Nov. 1967 p 50–65
(JPRS-45339) CFSTI: $3.00

A limited survey on Soviet powder metallurgy for nuclear fuels and construction materials in atomic technology is presented. Discussed are preparation technologies for uranium powder, precipitation-hardened uranium cermet, thorium powder, powdery solids of uranium–zirconium solutions, beryllium powder, as well as various cermet alloys on magnesium and zirconium matrices. Different compounds of boron rare earth metals, as well as sintered materials from these compounds were also evaluated for their neutron absorbing properties. G.G.

N68-24215# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
THE EFFECTS OF HYDROSTATIC PRESSURES TO 8250 PSI ON ELECTROLYTIC HYDROGEN IN IRON

John J. De Luccia 24 Jan. 1968 56 p refs
(NADC-MA-6726; AD-667596)

An apparatus for the determination of electrochemical parameters as well as diffusion parameters of hydrogen in iron at hydrostatic pressures up to 20,000 psi using the hydrogen permeation technique is described. Values of the diffusion coefficient and solubility of hydrogen in iron at pressures to 8250 psig are listed. The effect of pressure on the cathodic hydrogen evolution kinetics is noted. All experiments were performed on Armco iron in 0.1N H_2SO_4 + 0.001N HCl at 21C. Author (TAB)

N68-24250# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
APPLICATION OF FILIFORM TUNGSTEN TO REINFORCE METALS
A. G. Starliper and H. Kenworthy May 1968 23 p refs
(BM-RI-7130)

An investigation was made to determine the feasibility of utilizing fine tungsten wires to reinforce a number of nonferrous metals and alloys and a superalloy, S-816. The composites of tungsten filament and metals were chosen to attain elevated temperature strength and corrosion resistance. Oriented clean or precoated tungsten wires were incorporated with the other metals by extrusion, swaging, and infiltration casting. Although widely varying characteristics were found in the composites, none were considered satisfactory for high-temperature use, chiefly because of reactions between the matrix metal–tungsten surface. Diffusion, solution, and chemical reactions between matrix and tungsten wires were sufficiently slow for some combinations, such as 15 v/o S-816, to exhibit increased high-temperature strength for a limited time. A few metals failed to wet or bond to the tungsten surfaces, while a few responded after precoating with a third metal. Author

N68-24268# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
PROPERTIES OF NEW HIGH-TEMPERATURE TITANIUM ALLOYS
A. W. Hodge and D. J. Maykuth 15 Feb. 1968 48 p refs
(Contract F33615-68-C-1325)
(DMIC-MEMO-230; AD-667533)

The memorandum compares and summarizes the compositions, recommended heat treatments, and basic physical and mechanical properties for a group of 12 relatively new titanium alloys. Most of these were developed for service above 600F as bar and forging alloys and can be considered as alloys of the super alpha class. These include the Ti-6Al-2Sn-4Zr-2Mo, Ti-5Al-5Sn-5Zr, and Ti-7Al-12Zr compositions, which were developed in the United States, as well as the series of IMI-679, -680, -EX 684, and -EX 700 alloys and of Hylite 50, 51, 55, 60, and 65 alloys, all of which were developed in the United Kingdom. In addition, some preliminary data are presented for a silicon-modified version of the Ti6Al-2Sn-4Zr-2Mo alloy. Author (TAB)

N68-24317# Norton Co., Worcester, Mass. Refractories Div.
CORROSION PROTECTION VIA FLAME SPRAYING
W. M. Wheildon, W. H. McMakin (Metallizing Co. of Am. Inc., Chicago), and C. C. Esty [1967] 38 p refs Presented at AFML 50th Anniv. Symp. on Corrosion of Mil. and Aerospace Equipment, Denver, 23–25 May 1967

Corrosion proofing of metal structures has been a long standing problem. Many approaches to a solution have been taken such as painting, plating, galvanizing, anodizing, chromizing, flame spraying, and many others. None, perhaps, are as versatile as thermal or flame spraying for the application of a wide variety of protective surfacing. Several processes or systems are available, each having particular merits for the materials being handled and the type of protective coating desired. Corrosion tests of metallized coated steels for periods in excess of a decade, in marine and industrial atmospheres, show a good degree of protection by selected materials. Under more severe environments, ceramics and composites are beginning to find a place. Author

N68-24325*# Dow Chemical Co., Midland, Mich.
R AND D EVALUATION OF A LIGHTWEIGHT, HIGH STRENGTH MAGNESIUM ALLOY Quarterly Report, 1 Nov. 1967–1 Feb. 1968
George S. Foerster 1 Feb. 1968 9 p
(Contract NAS5-10398)
(NASA-CR-94601; QR-3) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Magnesium ternaries containing 10–20% scandium and selected additives (Zr, Mn, Al, Zn, Ag, Pb, Sn, Bi, Cd, Li, Y, and In) were evaluated. The addition of 6% Ag, 10–20% Cd, or 5% Li markedly strengthen Mg–Sc extrusions. Mg–10Sc—5 Li naturally ages after solution heat treatment to a CYS of about 50 ksi. The addition of 6% silver or 10% cadmium increases the yield strength of Mg–20Sc extrusions to about 60 ksi. Comparison with small scale extrusions of two commercial, high strength magnesium alloys reveals the marked superiority of the Mg–Sc alloys in room temperature strength and also indicates good high temperature properties. Author

N68-24320 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A SOLUBILITY INVESTIGATION OF SN IN NB IN NB–10% SN ALLOYS [PROBA SPRAWDZENIA ZAKRESU ROZPUSZCZALNOSCI SN W NB NA PRZYKLADZIE STOPU NB-10% SN]
W. Rutkowski and Z. Horubala 1967 19 p refs In POLISH; ENGLISH summary
(IBJ-877/XIV/PS) CFSTI: $3.00

Metallography, roentgenography and hardness were tested on alloys containing Nb + 10% Sn. The specimens were produced from powders in a powder metallurgy technique. It could be stated, that the alloy under investigation is a solid solution of Sn in Nb. Experiment results are in accord with some former investigations on Nb–Sn alloys and their phase diagrams. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-23202# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
ELECTROPLATED NICKEL RAIN EROSION RESISTANT COATING Technical Report, Jul. 1965–Sep. 1966
James H. Weaver Jan. 1968 32 p refs
(AFML-TR-67-356; AD-666674)

The problem of protection of plastic components of advanced aircraft and missile weapon systems from the damaging effect of rain impingement at high speeds is severe and will become more severe in the future. Metal coating of plastic laminates is particularly applicable to plastic structural members such as wing leading edge of aircraft, helicopter rotor blades, and turbine engine compressor blades. Epoxy, polyester, and polybenzimidazole laminates were electroplated with a minimum of 12 mil of nickel and exposed to a rain environment at subsonic speeds. The plated epoxy endured 160 minutes, the plated polyester 180 minutes, and the plated polybenzimidazole 473 minutes with no visible evidence of erosion. The latter represents a 40-fold increase in resistance over specification neoprene coatings. Supersonic rocket sled test runs at

Mach 1.5 and 2.0 showed no evidence of erosion. The 60-degree angle exposure at Mach 2.5 showed mild damage. Electroformed nickel patches were bonded to stabilizer edges of an F-100 airplane which subsequently made a total of 163 penetrations into rain and hail storms for a total time of 440 minutes with no indication of erosion of the electroformed nickel. Substrate preparation and nickel thickness were found to be the most important criteria for obtaining good rain erosion resistant coatings. Mechanical interlocking achieved by sandblasting appears to be the most efficient method to obtain adhesion to the inert surface. A minimum thickness of 12 mil of the nickel coating on the laminates is recommended to obtain protection from rain erosion. Author (TAB)

N68-23264 Texas A&M Univ., College Station.
THE RHEOLOGY OF POLYMERS
Mohammed Abu Naser (Ph.D. Thesis) 1966 370 p
Available from Univ. Microfilms: HC $16.65/MF $4.75 Order No. 67-4713

A technique for prediction of the volumetric flow rate in a circular pipe from rotational viscometric data has been developed and demonstrated experimentally for Cyanamer P250 polyacrylamide and sodium carboxymethyl-cellulose. Both polymers in aqueous solution show strong non-Newtonian behavior in their flow properties for all the concentrations at five different temperatures. The difference between the predicted and measured flow rates was 11.43% maximum, the average difference being 3.40% for both polymers in solution. A new rheological equation of state has been suggested that will fit data for all types of fluids, Newtonian and non-Newtonian. The flow properties of the two polymers in aqueous solution of different concentrations have been investigated. The dependence of apparent viscosity on rate of shear, temperature, and concentration has been studied. These properties are typical of non-Newtonian fluids. Dissert. Abstr.

N68-23298# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ON THE DEVELOPMENT OF TWO-PHASE STRUCTURE IN GLASSES, WITH SPECIAL REFERENCE TO THE SYSTEM BAO–SiO_2 Interim Technical Report
T. P. Seward, III, D. R. Uhlmann, and D. Turnbull Jan. 1968 66 p refs
(Contract N00014-67-A-0298-0009)
(TR-15; AD-666983)

The technique of vapor deposition was used to obtain homogeneous glass films of several BaO-SiO2 compositions in the region of the metastable miscibility gap. The films were electron beam heated in the electron microscope and the process of phase separation was observed. At low BaO contents, the separation was characterized by the appearance of discrete, amorphous, second-phase particles. For compositions near the center of the miscibility gap, the separation process resulted in two continuously interconnected phases similar to those found in the corresponding bulk glasses. In the thinnest of these films the process was observed to proceed by the coalescence of isolated particles into the interconnected second-phase submicrostructure. At high BaO contents, rapid crystallization of the films prevented study of the separation process. Two processes which could lead to the coalescence of discrete second-phase particles into an interconnected submicrostructure are discussed. It is suggested that coalescence may take place when either of these processes results in the particles approaching within some small distance of each other. The results indicate that observations of final phase-separated morphologies are inadequate for specifying the processes by which those morphologies arose. Author (TAB)

N68-23299# Gulf General Atomic, San Diego, Calif.
FRICTION AND WEAR IN PSC CARBON AND GRAPHITE CORE SUPPORT MATERIALS
O. M. Stansfield 7 Dec. 1967 37 p refs
(Contract AT(04-3)-633)
(GAMD-8374) CFSTI: HC $3.00/MF $0.65

Commercial graphite friction couples were rubbed with oscillating motion 2500- or 5000-inches in dry helium at room temperature, 400 and 800°C. Loads of 17.7 pounds were used to produce nominal contact pressures of 250 to 500 psi. The PGX and MHLM couples were also rubbed under a 4.3 pounds load (60 to 120 psi). A baked carbon, and MoS_2 impregnated graphite were rubbed on steel 250-inches in dry helium at R.T., 100 and 200°C under a 35.3 pounds load. Friction and wear were correlated with rubbing distance, temperature, load, pre-treatment of PGX surfaces, and surface roughness of the steel. The graphite on graphite couples showed similar friction and wear properties. There apparently was a wearing-in process which caused the friction of graphite outgassed at 400°C first to increase and then decrease during initial sliding (10 to 100 inches). After the initial fluctuation friction was relatively constant. Friction and wear decreased with increasing temperature. The dominant friction coefficient was approximately 0.4, at R.T. and 0.3 at 800°C. Author (NSA)

N68-23333# Army Natick Labs., Mass. Clothing and Organic Materials Div.
STUDIES ON THE STRUCTURE OF RUBBERY POLYURETHANES Technical Report, Jan. 1966–Mar. 1967
Stuart B. Clough and Nathaniel S. Schneider Jun. 1967 10 p refs
(TR-67-77-CM; AD-666753)

A variety of methods were used to obtain information about the structural organization and transitions in several polyester and polyether type polyurethanes in order to gain a better understanding of the factors which control the mechanical behavior and water vapor transmission of this important class of polymers. Thermal scanning methods reveal three characteristic transitions which are common to all samples. The low temperature transition is the major glass transition. An intermediate transition in the range of 60-80C is ascribed to urethane to polyester or polyether hydrogen bonding while the highest transition at 130-150C is attributed to interurethane bonding. A transition at 205C, which occurs only in the polyether samples, coincides with the melting of birefringent regions and is believed due to urethane crystallites. Light scattering measurements on this turbid sample indicate the existence of a wide range of structural order. Although crystallinity is absent in the unoriented samples, there is x-ray evidence of the stress induced crystallization of polyether or polyester segments. It is concluded that segregation of prepolymer and urethane segments into domain-like structure occurs in both types of polymers, but to a higher degree in the polyether than in the polyester based polymers, possibly due to restrictions in the latter imposed by interactions of the urethane and ester groups. Author (TAB)

N68-23334# New York Univ., N. Y. School of Engineering and Science.
THE DEVELOPMENT OF A CONSTITUTIVE RELATION FOR NEOPRENE BALLOON FILM Interim Scientific Report
Harold Alexander Jul. 1967 69 p refs
(Contract F19628-67-C-0241)
(NYU-AA-67-108; AFCRL-67-0573; SR-1; AD-666930)

The physical and mechanical characteristics of neoprene film, a commonly used expandable-type balloon skin material, are presented for the purpose of developing constitutive equations that can be used in balloon analyses. Day balloon film is found to be an almost perfectly elastic material through an extremely large range of deformations. A survey of previously proposed elastic constitutive equations for rubber-like materials is presented and all are found to be inadequate for neoprene. Consequently, a new

constitutive relation based on the attempts of previous investigators and experiments performed by the author is proposed. It is shown to be a generalization of most earlier theories. Author (TAB)

N68-23397* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE DEVELOPMENT OF POLYBENZIMIDAZOLE COMPOSITES AS ABLATIVE HEAT SHIELDS
Robert R. Dickey, John H. Lundell, and John A. Parker [1967] 8 p refs
(NASA-TM-X-61092) CFSTI: $3.00 CSCL 11I

In formulating some polybenzimidazoles (PBI), prepolymers were synthesized by thermally condensing 3, 3'-diaminobenzidine and diphenylisopthalate to give low molecular weight prepolymer resins. An ablation screening test program was conducted to evaluate four types of low density PBI composites: high molecular weight linear PBI; thermally crosslinked PBI; chemically crosslinked PBI obtained from preoxidized 3,3'-diaminobenzidine; and chemically crosslinked PBI obtained from trimeasate derivatives. Test results are compared with those obtained on low-density phenolic nylon. Preliminary data indicate: (1) The linear PBI composite has a lower mass removal rate than low-density phenolic nylon in both an oxidation-only and a combined oxidation-shear environment. (2) The PBI performance can be improved by crosslinking. (3) A small increase in resin content provides better wetting of the filler materials and a reduced mass removal rate. Char formation in PBI is described, along with chemical processing and characterization techniques. M.G.J.

N68-23404*# Southern Research Inst., Birmingham, Ala.
EFFECTS OF STERILIZATION AND VACUUM EXPOSURE ON POTENTIAL HEAT SHIELD MATERIALS FOR UNMANNED MARS MISSION
C. M. Pyron, Jr. and C. D. Pears Washington NASA Apr. 1968 94 p refs
(Contract NAS1-5448)
(NASA-CR-66557) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Sixteen candidate heat shield materials were subjected to a screening program consisting of dry heat sterilization in nitrogen, ethylene oxide decontamination, and exposure to vacuum of 10^{-7} to 10^{-8} torr for two weeks. Flexural tests were made on as-received and exposed specimens at temperatures ranging from 70°F to −200°F in order to evaluate the effects of sterilization, vacuum, and low temperatures on the mechanical properties. Thermogravimetric data were also obtained on as-received and exposed specimens. Of the 16 materials evaluated, five survived all flexural tests without a single failure in the as-received and exposed conditions. The flexural strengths and moduli of most of the materials were reduced significantly by the sterilization-vacuum exposures. Author

N68-23428# Army Materials and Mechanics Research Center, Watertown, Mass.
ROOM TEMPERATURE STRENGTH OF PYROLYTIC GRAPHITE AS AFFECTED BY MICROSTRUCTURE AND BORON CONTENT
Samuel J. Acquaviva and R. Nathan Katz Feb. 1968 19 p refs
(AMMRC-TR-68-04; AD-666767)

The strengths of pyrolytic graphites possessing four varieties of microstructure ranging from coarse-coned singularly nucleated to fine-coned continuously nucleated were examined. The fine-coned structure gave substantially higher strengths. Boron-doped pyrolytic graphite with percentages of boron varying from 0.25 to 3.3% were evaluated in terms of their modulus and flexural strength. The higher boron content material (1 to 3.3% B) achieved strengths as much as fifty percent greater than the undoped material. Author (TAB)

N68-23498# Army Materials and Mechanics Research Center, Watertown, Mass. Ceramics Research Lab.
A SURVEY OF POTENTIAL CERAMIC ARMOR MATERIALS
Jacob J. Stiglich, Jr. Mar. 1968 10 p ref
(AMMRC-MS-68-04; AD-666766)

A list of materials having potential armor application is presented along with values of density, Young's modulus, and hardness for each material if such data is available. Some ideas for future research and development work in this field are presented to illustrate the directions in which it is believed that future improvements lie in the field of ceramic armor. Author (TAB)

N68-23575# General Electric Co., Schenectady, N. Y. General Chemistry Lab.
COPOLYMER COMPOSITION AND TACTICITY Technical Information Series
F. P. Price Jul. 1967 110 p refs
(Rept.-67-C-271)

Report is concerned with the application of Markovian mathematics to the description of copolymer chains. Stereoregular polymers are treated as a special case. Transient and steady-state conditions are described and distribution of sequences of various kinds are considered. Author

N68-23577# United Kingdom Atomic Energy Authority, Harwell (England). Ceramics Div.
AN X-RAY STUDY OF THE VARIATION OF THE LATTICE PARAMETERS OF ALUMINA, MAGNESIA AND THORIA UP TO 2000°C
P. J. Baldock, W. E. Spindler, and T. W. Baker Jan. 1968 14 p refs
(AERE-R-5674) CFSTI: HC $3.00/MF $0.65

The thermal expansions of alumina, magnesia, and thoria have been determined using a high temperature X-ray diffractometer. The expansion of alumina is anisotropic, the expansion in the c-direction being about 10% greater than that in the a-direction. The values of the lattice parameters are given. The expansion of magnesia is given as being about 4% greater than that obtained earlier. Thoria has been found to exist in two distinct lattice parameters at room temperature, both values having already been reported previously. The expansion of the modification with the higher lattice parameter is also given. Author

N68-23614# Defense Dept., Washington, D. C.
INTERIOR COATING SYSTEMS FOR SURFACES IN CONTACT WITH PETROLEUM FUELS Technical Manual
Mar. 1968 57 p refs
(AD-666969)

This manual is intended to be a technical reference and guide to the materials, application methods, inspection techniques and specifications that will yield the best internal coatings for surfaces of containers in contact with petroleum fuels. Its purpose is to serve as a tool that will help toward improved and uniform practices in the selection and application of the most appropriate coatings. Comments are included on coating surfaces of containers--from the 5-gallon can to the largest storage tank or tank vessel, both metal and nonmetal, whether used for storage or for handling military fuels. TAB

N68-23701# General Electric Co., Schenectady, N. Y. General Chemistry Lab.
CHARACTERIZATION OF POLYMER NETWORKS Technical Information Series
A. R. Shultz Jul. 1967 26 p refs
(Rept.-67-C-291)

Characterization of polymer networks has been attempted principally by four methods: (1) determination of gel content; (2)

determination of rubber elasticity of the network; (3) determination of network swelling by equilibration with diluents; and (4) estimation of branch point density by chemical analysis or by reactant composition used in the network formation. This report makes reference to these areas, but does not attempt any extensive review of them. Attention is focused on branch point determination in polymer networks. Some examples of such determination attempts on networks prepared by different procedures are discussed. The desire is to indicate the nature of existing network branch point enumeration methods, and invite proposals for improved or novel methods.
Author

N68-23704# General Electric Co., Schenectady, N. Y. General Chemistry Lab.
SURFACE PHOTOPOLYMERIZATION OF VINYL AND DIENE MONOMERS Technical Information Series
A. N. Wright Jul. 1967 8 p refs
(Rept.-67-C-290)

Surface films are deposited during ultraviolet-irradiation of metallic and nonmetallic substrates in contact with monomeric vapors. The rates of film deposition vary inversely with the temperature at the interface and are linear in deposition time. The properties of the films deposited from butadiene, hexachlorobutadiene, and tetrafluoroethylene are described. The polymerization of C_4Cl_6 represents extension of the irradiation technique to deposition of unique (perchlorinated) materials from gases not subject to conventional forms of polymerization. The films deposited from C_2F_4 show the presence of some CF_3 groups and appear to be of rather low molecular weight. The self supporting nature of the extremely thin films that may be deposited from the ultraviolet technique greatly facilitates morphological studies. Electron diffraction measurements indicate the occurrence of single-crystal material as a minute constituent of the films from all monomers.
Author

N68-23737# Atomic Energy Establishment, Winfrith (England).
DETERMINATION OF APPARENT DENSITIES OF PLUTONIUM DIOXIDE SPHEROIDS
W. J. Symons and B. K. Robinson Jan. 1968 7 p
(AEEW-M-797) CFSTI: HC $3.00/MF $0.65

The determination of the apparent density of production batches of plutonium dioxide spheroids produced by a sintering process is described. An evacuated density bottle is filled with mercury and weighed, with and without a weighed sample present. Results obtained on seven batches of plutonium dioxide gave an average density of 10.55 g/cc, with a relative deviation of ±1.2% at 1 sigma.
NSA

N68-23748 Michigan State Univ., East Lansing.
MOLECULAR FORCES AND ELASTIC CONSTANTS OF POLYETHYLENE SINGLE CRYSTALS
Joginder Nath Anand (Ph.D. Thesis) 1966 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-1593

Lamellar polyethylene single crystals have a folded-chain structure in which planar zigzag segments of molecules take an orthorhombic lattice. For these crystals, nine independent elastic constants appear in the generalized Hooke's law. Thus, they are inherently quite anisotropic. Their anisotropy is enhanced further by the directional intra- and intermolecular forces. Intramolecular forces are due to the covalent C–C bonds forming the chains, and are much stronger than the intermolecular London dispersion-type of van der Waals forces. The latter have been approximated by a 6–12 Lennard–Jones potential involving two unknown constants, the ratio of which is fixed by the equilibrium separation to give a minimum in the potential. Their values are determined by comparing the computed crystal potential energy and the experimentally-determined cohesive energy, and are found to be comparable with those of argon.
Dissert. Abstr.

N68-23776# General Electric Co., Schenectady, N. Y. Research and Development Center.
METASTABLE IMMISCIBILITY IN THE BORON TRIOXIDE SILICON DIOXIDE SYSTEM
R. J. Charles and F. E. Wagstaff Jun. 1967 6 p refs
(Rept.-67-C-244)

Utilizing the B_2O_3–SiO_2 phase diagram and a simple solution model the boundary of a sub-liquidus miscibility gap was estimated. The predicted coexistence boundary was symmetrical and nearly flat and extended across the complete binary. A consolute temperature was estimated at 520°C. Using these data, compositions and temperatures were selected as being most likely to lead to phase separation in this system. Gradient furnace heat treatments of these compositions over the temperature ranges estimated did, in fact, result in phase separation. The onset of such separation was found to correspond closely to the coexistence boundary initially predicted. The calculated and experimental results also indicate that temperatures and compositions exist wherein metastable three-liquid formation in alkali metal oxide-borosilicates will occur.
Author

N68-23804# General Electric Co., Schenectady, N. Y. Research and Development Center.
ELECTRICAL PROPERTIES OF INSULATING MATERIALS
K. N. Mathes Jun. 1967 10 p
(Rept.-67-C-255)

Electrical breakdown, resistivity, and dielectric loss are surveyed briefly from the electrical application and measurement viewpoints. The range of properties likely to be obtained as well as the significance of design and ambient variables are discussed.
Author

N68-23806# General Electric Co., Schenectady, N. Y.
IONIC TRANSPORT AND MEMBRANE POTENTIALS IN AMORPHOUS OXIDES
R. H. Doremus Jun. 1967 19 p refs
(Rept.-67-C-219)

To aid in understanding the electrical conductance and potential across amorphous oxide films, some experimental and theoretical results on ionic transport in bulk oxide glasses are reviewed. Results on alkali and hydroxyl ion movement in fused silica are perhaps the most pertinent; results on other glasses help to test theories and to show the effects of additives and hydration of the glass. The relation of electrical potentials across ion-exchanging glasses to ionic properties is also discussed.
Author

N68-23880# General Electric Co., Schenectady, N. Y. General Chemistry Lab.
ELECTRICAL PROPERTIES OF POLYMERS Technical Information Series
K. N. Mathes Jun. 1967 52 p refs
(Rept.-67-C-257)

This survey of the electrical properties of plastics has been written for inclusion as supplementary notes to a presentation at the 1967 Polymer Conference. A background of dielectric theory is given and supported by a summary of dielectric properties for a variety of polymeric materials. The ways in which voltage breakdown, resistivity dissipation factor and capacitance vary with ambient and service factors—i.e., temperature, moisture exposure and time—are outlined. The importance of considering properties in the light of such variables, rather than as a single value, is emphasized.
Author

N68-23945# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Metallurgy and Ceramics Research Lab.
IMPROVED ZIRCONIA REFRACTORIES FOR HYPERSONIC WIND TUNNEL STORAGE HEATERS

Larry L. Fehrenbacher *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 23 p refs (See N68-23931 13-34)

A research study designed to determine the optimum configurations and compositions of ceramic materials for heater matrices and insulation in hypersonic wind tunnels is reported. Focused on is the product development and testing of zirconia refractories for use in the construction of storage heaters for a large TRIPLTEE (True Temperature Tunnel) blowdown facility which will be used in studying aerodynamic heating effects on materials and structures. Described are (1) the relevant property parameters of the ceramics and their application in design of the heater vessel, and (2) results of engineering performance tests of various commercial zirconia matrix and insulation materials. S.C.W.

N68-23980# Technisch Documentatie en Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).

BIBLIOGRAPHY ON APPLICATIONS OF PLASTICS [TOEPASSINGEN VAN KUNSTSTOFFEN]

D. C. van Royen, comp. and H. J. Poolman, comp. Nov. 1967 165 p refs

(TDCK-50062) CFSTI: HC $3.00/MF $0.65

This bibliography aims to give an insight into new application possibilities for plastics by listing a number of works on existing applications. The reference works were published mainly during the period 1959–66. Abstracts or short summaries in English, German, or Dutch are given for each entry. The works are arranged according to area of application and cover the following: (1) electrical engineering; (2) packaging; (3) coating; (4) machinery parts; (5) shipbuilding; (6) aircraft engineering; (7) automotive engineering; (8) tire cords; (9) insulation and plastic foams; and (10) pipes. Several works on military applications are included. K.W.

N68-24054 Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.

PRINCIPAL REPRESENTATIVES OF CARBORANESILOXANE (DEXSIL) POLYMERS AND THEIR PROPERTIES

Hansjuergen A. Schroeder Apr. 1968 22 p refs Presented at Am. Chem. Soc. Spring Meeting No. 93 of Rubber Chem. Div., Cleveland, 23–26 Apr. 1968

(Contract Nonr-3395(00))

(TR-40; AD-667831)

Two members of the poly-m-carboranesiloxane family were selected for extensive testing to determine their potential in high temperature applications between 500 and 900 F. Efforts were concentrated on an insoluble raw gum which lends itself primarily to molding operations; its synthesis was developed into a routine operation. Volatile loss determinations, long term heat-aging studies, compression set tests, shrinkage and electrical property measurements were conducted on variably compounded vulcanizates. Their tensile strength and elongation could be improved by increased filled loading in conjunction with modified molding techniques. End use items such as O-rings and other seals, diaphragms and electrical connector inserts are now undergoing application testing. For coatings and related uses, a soluble viscous liquid form is best suited and can be easily applied on metals or fabrics from aromatic solvents. Curing does not require peroxides and is achieved between 300 and 600 F. Author (TAB)

N68-24248 Princeton Univ., N. J. Frick Chemical Lab.

VISCOSITY AS A FUNCTION OF SHEAR RATE

Arthur V. Tobolsky and L. L. Chapoy 29 Mar. 1968 12 p refs

(Contract N00014-67-A-0151-0011)

(RLT-105; AD-667843

Polymer viscosity is derived as a function of rate of shear. The basic idea introduced is that the polymer attains a limiting strain in the melt viscosity instrument. This limiting strain is perhaps a braking strain. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-23079# Wisconsin Univ., Madison. Mathematics Research Center.

SOME VARIANTS OF A FIXED POINT THEOREM OF KRASNOSELSKII AND APPLICATIONS TO NONLINEAR INTEGRAL EQUATIONS

M. Z. Nashed and J. S. W. Wong Aug. 1967 19 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-772; AD-666606)

Several fixed point theorems are obtained for the sum of two operators, with applications to nonlinear integral equations of the mixed type. Author (TAB)

N68-23094 California Univ., Berkeley.

GAMES, PURSUIT–EVASION AND RENDEZVOUS PROBLEMS

Jean-Paul Jacob (Ph.D. Thesis) 1966 135 p

Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-5085

This thesis deals with games of the form (X, Y, f), where X, Y, are sets and f is a mapping from X x Y into the reals. A pair $(\bar{x},\bar{y})$, $\bar{x} \in X$, $\bar{y} \in Y$ is defined to be a solution to this game if $f(x,y) = \min_{y\in Y} \max_{x\in X} f(x,y) = \max_{x\in X} \min_{y\in Y} f(x,y)$. Sufficient conditions for the existence of a solution to such a game are obtained when X and Y are compact, convex subsets either of a finite dimensional space or of a Hausdorff, locally convex linear topological space and when the payoff function f is quasi-convex–quasi-concave. Such games include broad classes of pursuit–evasion games and differential games. Rendezvous problems, in which two dynamical systems are joint required to perform a maneuver subject to separate costs, are considered separately from pursuit–evasion games. This is necessitated by the fact that the standard assumptions of game theory become so restrictive for these problems as to render them trivial. A set of sufficient conditions for the existence of the solutions to rendezvous problems is established and the computation of solutions is explored to some extent. Dissert. Abstr.

N68-23108# Aerospace Corp., San Bernardino, Calif. Technology Div.

CERTAIN NUMERICAL PROPERTIES OF THE LEGENDRE FUNCTION AND THE ASSOCIATED LEGENDRE FUNCTION

P. S. Jorgensen Mar. 1968 16 p

(Contract F04695-67-C-0158)

(TOR-0158(S3930-43)-3; AD-666919)

The Legendre function and the associated Legendre function are orthogonal sets of functions, i.e., the integral of the square of a normalized function is unity and the integral of any pair of functions of different degree is zero. This will be only approximately true when ideal integration is replaced by a simple numerical summation. In doing this, certain curious numerical properties have been observed which are discussed by a few illustrative examples. The practical implication of these numerical aspects of the Legendre function, when performing harmonic analysis in spherical coordinates, is discussed. Author (TAB)

N68-23123# Wisconsin Univ., Madison. Mathematics Research Center.

AN ITERATIVE PROCEDURE FOR THE SOLUTION OF NONLINEAR EQUATIONS IN A BANACH SPACE

S. K. Aalto Jul. 1967 44 p refs

(Contract DA-31-124-ARO-D-462)

(MRC-TSR-774; AD-666607)

In 1964, Zarantonello published a constructive method for the solution of certain nonlinear problems in a Hilbert space. The

present report extends the method in various directions including a generalization to a Banach space setting. A revealing geometric interpretation of the method yields guidelines for the analysis. Author (TAB)

N68-23138# Wisconsin Univ., Madison. Mathematics Research Center.

A NEW PROOF OF THE MAXIMUM PRINCIPLE FOR DOUBLY HARMONIC FUNCTIONS

H. B. Mann, J. Mitchell, and L. Schoenfeld Sep. 1967 9 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-795; AD-666610)

Using the theory of distributions, a new proof is given of the maximum principle for functions f which are nonconstant, Lebesgue integrable and doubly-harmonic on a domain in E sub 2m. TAB

N68-23153# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

MACHINE SEQUENCING VIA DISJUNCTIVE GRAPHS: AN IMPLICIT ENUMERATION ALGORITHM

Egon Balas Feb. 1968 20 p refs Supported in part by IBM

(Contract Nonr-760(24))

(RR-125; AD-666810)

A disjunctive graph is a generalized graph some of whose arcs are disjunctive. Such graphs translate a variety of scheduling-type problems, like machine sequencing. The latter problem can be reduced to that of finding a minimaximal path (shortest critical path) in a disjunctive PERT network. The present paper describes an implicit enumeration algorithm for finding such a path by solving a sequence of PERT problems. The algorithm finds at an early stage a local optimum; thus one can stop at any moment with a reasonably good feasible solution. The number of PERT problems whose data are to be stored at any given moment cannot exceed the number of disjunctive pairs of arcs. Author (TAB)

N68-23154# Northwestern Univ., Evanston, Ill. Technological Inst.

ON GENERALIZED MATRIX FUNCTIONS

John B. Hawkins and Adi Ben-Israel Jan. 1968 22 p refs *Its* Systems Res. Mem. No. 193

(Contracts Nonr-1228(10); DA-31-124-ARO(D)-322; Grant NSF GP-7550)

(AD-666813)

The paper contains 2 sections. In section 1 the spectral theory for rectangular complex matrices, as given by Penrose and Hestenes is reformulated so as to include the spectral theory for normal matrices as a special case. These results, which are mostly well known, are used in section 2 to study matric functions of rectangular complex matrices. These functions are shown in theorem 4 to satisfy an appropriate version of the Fantappie requirements. Theorems 5 and 6 are the analogs of Cauchys integral theorem and Taylors theorem respectively. Author (TAB)

N68-23157# Wisconsin Univ., Madison. Mathematics Research Center.

BOUNDARY VALUE PROBLEMS FOR LINEAR SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS INVOLVING MANY SMALL PARAMETERS

R. E. O'Malley, Jr. Dec. 1967 48 p refs

(Contract DA-31-124-ARO-D-462)

(MRC-TSR-821; AD-666613)

Complete asymptotic solutions, including boundary layer terms are obtained. Results are related to those for singular perturbations of scalar equations. Author (TAB)

N68-23183 Pennsylvania Univ., Philadelphia.

THE CENTERS OF REAL SIMPLE LIE GROUPS

Richard Carl Glaeser (Ph.D. Thesis) 1966 52 p

Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-3072

Let G be a real form of the simply connected complex simple Lie group $\tilde{G}^C$ and let $\tilde{G}$ be the universal covering group of G. The centers of G and $\tilde{G}$ and the fundamental group of G are computed for each of the anisomorphic real forms. A method for finding the center of $\tilde{G}^C$ using the Lie algebra g^C of $\tilde{G}^C$ is discussed. A modification of this procedure is used to find the center of $\tilde{K}$, where $\tilde{K}$ is the universal covering group of a maximal compact subgroup K of G. A method is then given for obtaining the centers of G and $\tilde{G}$ using the center of $\tilde{K}$. The same technique yields the fundamental group of G. The aforementioned groups are computed for the real forms of the first and second categories respectively. The real form G is a linear covering group. That is, G has a faithful linear representation and if G_1 is a faithfully representable connected Lie group locally isomorphic to G, then G is a covering group of G_1. Dissert. Abstr.

N68-23188# Wisconsin Univ., Madison. Mathematics Research Center.

ON MULTIPLIERS OF DIFFERENCE SETS

H. B. Mann and S. K. Zaremba Jan. 1968 10 p refs

(Contract DA-31-124-APO(D)-462)

(MRC-TSR-793; AD-666609)

Let D be an Abelian difference set v,k, lambda with k-lambda = n = 2n sub 1, n sub 1 odd. For every prime divisor of q of n sub 1 let t be identically equal to q(superscript (f sub q)) (v). If n > lambda, (n sub 1, lambda) = 1 then t is multiplier of D. Necessary conditions are given for the existence of a difference set with v = 9 q squared -2, k = 6 q squared -2, lambda = 4 q squared -2. TAB

N68-23189# Wisconsin Univ., Madison. Mathematics Research Center.

COMPARISON THEOREMS FOR VOLTERRA EQUATIONS WITH RETARDED ARGUMENT

A. I. Logunov and Z. B. Caljuk Sep. 1967 10 p refs Transl. into ENGLISH from Russian

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-780; AD-666608)

Upper and lower bounds are obtained for solutions of Volterra integral equations with retarded argument. Author (TAB)

N68-23190# California Univ., Berkeley. Operations Research Center.

MAXIMIZATION OF SYSTEM RELIABILITY WITH LIMITED RESOURCES

Lawrence D. Bodin Jul. 1967 24 p refs

(Contracts Nonr-3656(18); DA-31-124-ARO(D)-331; Grants NSF GK-1684; NSF GP-7417)

(ORC-67-40; AD-666619)

The optimization of system reliability of a series parallel system containing t types of components is found where the cost of purchasing the components is disregarded, a component can be assigned to more than one component position, and a limited supply of components is available for assignment. The optimal solution is found by ranking the reliabilities of the components of each type and searching over these ranks in the orders specified in this paper. Author (TAB)

N68-23213# Northwestern Univ., Evanston, Ill. Technological Inst.

ON WEAKLY BALANCED GAMES AND DUALITY THEORY

Abraham Charnes, Kenneth O. Kortanek (Cornell Univ., Ithaca, N. Y.), and Mark Eisner (Cornell Univ., Ithaca, N. Y.) Feb. 1968 27 p refs *Its* Systems Res. Mem. No. 200

(Contracts Nonr-1228(10); DA-31-124-ARO(D)-322; Grant NSF GP-7550)

(TR-44; AD-666815)

The notion of a weakly balanced game under very general conditions involving no topology whatever is defined. The work of Schmeidler is extended by establishing duality results for a pair of (possibly) infinite dimensional linear programming problems arising from a generalized game. A necessary and sufficient condition is given in order that a separating hyperplane argument can be employed to prove the existence of a candidate core member for a weakly balanced game. This candidate is shown to be in the core if and only if the game is balanced. No use is made of topological ideas, but conditions are given under which the core member takes on values in a bounded set. The Charnes-Kortanek M-operator is used to characterize the redundancy of certain coalition values in restriction core membership. TAB

N68-23214 Georgia Univ., Athens.
FACTORS OF MANIFOLDS
Peter Warner Harley, III (Ph.D. Thesis) 1966 41 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-3551

In Chapter II of the dissertation we are concerned with the problem of factoring certain manifolds. Chapter III is concerned with the question, "For which manifolds M is it true that the cone over M is a topological manifold?" Using a theorem of J. C. Cantrell it is shown that the suspension of every fake 4-cell (a compact, contractible, combinatorial 4-manifold with boundary S^3) is I^5 if and only if the suspension of every homotopy 4-sphere is S^5. The first of these statements is proved by the author based on a recent announcement of a result due to A. V. Chernavskii concerning embeddings of topological manifolds. The second was previously known and proved by M. Hirsch, who appealed to results in differential topology. Several other theorems related to the above question are proved and the relationship to other classical conjectures are discussed. Finally, it is pointed out that, modulo several classical conjectures the answer to the above question is "cells and spheres." Dissert. Abstr.

N68-23228# Research Analysis Corp., McLean, Va. Advanced Research Dept.
A RELAXED INTERIOR APPROACH TO NONLINEAR PROGRAMMING
James E. Falk Dec. 1967 25 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-279; AD-666785)

The paper contains the mathematical validation of a new approach to mathematical programming problems based on a penalty-function method. The given problem is replaced by a second auxiliary problem, which in many cases may be solved by standard methods since it involves the maximization of a concave function of a single variable over an interval. The auxiliary problem is defined implicitly in terms of the constituents of the original problem. Examples are presented to illustrate the theoretical results. Author (TAB)

N68-23243# Illinois Univ., Urbana. Antenna Lab.
A MODIFIED RESIDUE CALCULUS TECHNIQUE Interim Scientific Report
R. Mittra, S. W. Lee, and G. F. VanBlaricum, Jr. Jan. 1968 34 p refs
(Contract AF 19(628)-3819)
(AFCRL-68-0079; TR-15; Rept.-68-1; AD-666670)

A modified residue-calculus technique is presented for the solution of a class of infinite sets of equations which typically arise in the boundary value problems involving modifications of basic Wiener-Hopf geometries. The central step in this method is the construction of a meromorphic function f(w) satisfying both certain criteria determined by the form of the infinite set of equations and an auxiliary requirement imposed by the edge condition. The solution is constructed by integrating certain functions related to f(w) in the complex w-plane. The special features of the method are: (i) No matrix inversion is necessary. (ii) The iterative procedure used to find the zeros of f(w) has a built-in convergence check based on a priori knowledge of the asymptotic behavior of the fields. (iii) Satisfaction of the edge condition is guaranteed. This method makes possible very accurate solutions to problems for which only solutions based on variational, quasi-static, or numerical means are available at the present time. A typical example of a waveguide discontinuity is included to illustrate the use of the method. Author (TAB)

N68-23290# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
DUALITY IN DISCRETE PROGRAMMING. 3: NONLINEAR OBJECTIVE FUNCTION AND CONSTRAINTS
Egon Balas Feb. 1968 25 p refs
(Contract Nonr-760(24))
(RR-121; AD-666627)

The results of Duality in Discrete Programming, are extended in this paper (which, however, is self-contained) to the case of dual programs with nonlinear objective function and nonlinear constraints. The symmetric dual nonlinear programs studied by Dantzig, Eisenberg and Cottle, as well as the dual nonlinear programs formulated by Wolfe, Mangasarian and Huard are generalized by allowing some of the variables to be constrained to belong to arbitrary sets of real numbers, and dropping the requirement that the objective function and the constraints be convex (concave) in these variables. The basic properties established for the above problems are shown to carry over, with some qualification, to their generalized counterparts which encompass, among others, various types of mixed-integer nonlinear programs. Author (TAB)

N68-23295# Navy Underwater Sound Lab., New London, Conn.
USE OF THE IMPLICIT FUNCTION THEOREM IN SOLVING SYSTEMS OF EQUATIONS
Marvin J. Goldstein 2 Feb. 1968 25 p refs Presented at the Numerical Analysis Workshop, Fort Collins, Colo., 9 Aug. 1967
(USL-858; AD-666971)

Applications of the implicit function theorem in solving systems of n equations in (n + p) unknowns subject to p nonlinear constraints are discussed. A generalized iterative technique that is defined for a sufficiently restricted region is derived for solving the set of (n + p) equations. The derivation employs Newtons method and assumes that the unconstrained (n + p) system of equations has a local vector function solution that satisfies the p constraints at a unique point in its prescribed region of definition. The implicit function theorem is further employed to derive mathematical formulas that characterize the conditions of the solutions of systems of linear equations and the zeros of polynomials with real coefficients. Author (TAB)

N68-23314*# Michigan Univ., Ann Arbor.
GENERAL GROUP-THEORETIC TRANSFORMATIONS FROM BOUNDARY VALUE TO INITIAL VALUE PROBLEMS
Tsung-Yen Na and Arthur G. Hansen Huntsville, Ala. NASA Marshall Space Flight Center Feb. 1968 54 p refs
(Contract NAS8-20065)
(NASA-CR-61218) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A systematic method using S. Lie's continuous contact transformation groups is developed in this report which enables one to search for all possible groups of transformations under which a given differential equation can be transformed from a boundary value to an initial value problem. Examples are worked out in detail as illustrations of the procedure. Author

N68-23352# Research Triangle Inst., Durham, N. C.
COMPARISON OF DESIGNS FOR DISCRIMINATING BETWEEN REGRESSION MODELS Technical Report, 1 Feb. 1967–31 Jan. 1968
A. Carl Nelson, Jr. Feb. 1968 16 p refs
(Contract DA-31-124-ARO(D)-323)
(AROD-5506.8-M; TR-6; AD-666788)

Several sequential design procedures for discriminating between two regression models have been suggested in recent years. The essence of the results is that the sequential design is essentially independent of which model is correct. This result is investigated in this study for the fixed sample size design and for the simple case of a linear versus a quadratic model, both through the origin, as this is the only case for which the sequential designs have been tabulated. The results here are substantially in agreement with those for sequential designs as the model dependence of the design allocations are not large by practical considerations. The approach suggested offers the possibility of designing a preliminary experiment for the sequential test procedure. Of course, in physical situations where the sequential design approach is not practical, the fixed sample approach will be necessary. Two criteria are considered in the selection of a design (1) an optimal design using a composite model and a minimal confidence region, and (2) an optimal design using the lack-of-fit test as given in the literature. The first approach is preferred for estimation of unknown parameters whereas the second is preferred for discrimination between the hypothesized models. Author (TAB)

N68-23376# RAND Corp., Santa Monica, Calif.
MATHEMATICAL FORMULATION: A PROBLEM IN DESIGN
A. Alan B. Pritsker (Arizona State Univ.), Lawrence J. Watters, and Philip M. Wolfe (Arizona State Univ.) Feb. 1968 22 p refs
(P-3790; AD-666902)

The relationship between formulation and design is examined. The main aspects of mathematical formulation are the development of definitions of variables and the functional relationships of the variables required to model the situation under study. There are many ways to attack these two aspects since there can be many mathematical formulations for the same problem description. The design of an efficient mathematical formulation is an activity analogous to other engineering design activities. In this paper the design aspects of mathematical formulation are discussed and an example illustrating the design considerations is presented. Author (TAB)

N68-23382# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
AN ADAPTIVE MULTICATEGORY PATTERN CLASSIFICATION SYSTEM
James Michael Pitt and B. F. Womack 22 Jan. 1968 106 p refs
(Grant AF-AFOSR-766-67A)
(AFOSR-68-0279; TR-43; AD-666898)

An adaptive, multicategory, pattern classification system for classifying statistical patterns is formulated. The system finds application in those instances when the probability densities and a priori probabilities of occurrence of the classes are unknown. The convergence rate and other special properties of the system are examined, including the special case where the expected loss due to misclassification by the system tends to the minimum expected loss which results when using the Bayes discriminant functions. In addition, a simulation of the system for a three-category problem using quadratic discriminant functions is presented. Author (TAB)

N68-23383# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
ASYMPTOTICALLY OPTIMAL DISCRIMINANT FUNCTIONS FOR PATTERN RECOGNITION
Charles T. Wolverton and Terry J. Wagner 15 Feb. 1968 49 p refs
(Grant AF-AFOSR-766-67)
(AFOSR-68-0381, TR-45; AD-666900)

The two category classification problem is considered. No a priori knowledge of the statistics of the classes is assumed. A sequence of labeled samples from the two classes is used to construct a sequence of approximations of a discriminant function which is optimum in the sense of minimizing the probability of misclassification but which requires knowledge of all the statistics of the classes. Depending on the assumptions made about the probability densities corresponding to the two classes, the integrated-square-error of the approximations converges in probability or with probability 1 to zero. The approximations are recursive and nonparametric. Rates of convergence are given. The approximations are used to define a decision procedure for classifying unlabeled samples. It is shown that as the number of labeled samples used to construct the approximations increases, the resulting sequence of discriminant functions is asymptotically optimal in the sense that the probability misclassification when using the approximations in the decision procedure converges in probability or with probability 1, depending on the assumptions made, to the probability misclassification of the optimum discriminant function. The results can be easily extended to the multicategory problem and to the case of an arbitrary Bayes risk (i.e., costs of misclassification not necessarily equal to 1). Author (TAB)

N68-23394# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
GENERATING ASSOCIATED RANDOM VARIABLES
James D. Esary and Frank Proschan Jan. 1968 21 p refs
Its Mathematical Note No. 546
(DI-82-0696; AD-667169)

The paper defines associated random variables and applies results to reliability models involving various types of maintenance. TAB

N68-23405 Texas A&M Univ., College Station.
AN INVESTIGATION OF THE FORMULATION OF LYAPUNOV FUNCTIONS FROM A PARTIAL DIFFERENTIAL EQUATION
Merle Michael Ray Whatley (Ph.D. Thesis) 1968 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-4731

A possibility of surmounting obstacles in the application of Lyapunov's theory lies in specifying a Lyapunov function as the solution to a certain partial differential equation involving the system parameters and the state variables which define the system. When the partial differential equation yields a closed form solution, this solution specifies an optimum Lyapunov function. The equation may, however, be nonlinear, precluding exact solution. Methods are considered which allow the solution of the partial differential equation by numerical procedures to obtain an approximate Lyapunov function. Although the optimum function is not obtained, the method generally allows the determination of stability information to any desired degree of accuracy. Successive orders of approximation are generated, using lower order approximations as a basis for iteration, on a computer. The iterative solution process is carried out using certain recursion relations. A description of the computer algorithm is given. Dissert. Abstr.

N68-23442# Wisconsin Univ., Madison. Mathematics Research Center.
ON A BOUNDARY VALUE PROBLEM FOR A NONLINEAR DIFFERENTIAL EQUATION WITH A SMALL PARAMETER
R. E. O'Malley, Jr. Dec. 1967 24 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-831; AD-666614)

The paper presents a method of obtaining a complete, uniformly valid asymptotic solution for a class of two-point boundary value problems for nonlinear differential equations with a small parameter multiplying the highest derivatives. Author (TAB)

N68-23475*# Techtran Corp., Glen Burnie, Md.
SCHWARZ'S FORMULA FOR THE $\partial w/\partial \bar{z} + b\bar{w} = 0$ [O FORMULE SHVARTSA DLYA URAVNENIYA $\partial w/\partial \bar{z} + b\bar{w} = 0$]

M. V. Sheveleva Washington NASA May 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 177, no. 3, 1967 p 531–534
(Contract NASw-1695)
(NASA-TT-F-11673) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This article concerns the derivation of a generalized Schwarz's formula for the equation $\partial w/\partial \bar{z} + b\bar{w} = 0$. Various methods are employed for this purpose, involving the use of differential equations, eliptical equations, analytic functions and complex variables. The stated purpose of the article is to express the nucleus of the generalized Schwarz's formula for the canonical regions, i.e. the half-plane and band, in terms of special functions by using the generalized Cauchy's formula. Such a formula could not be derived for the case of the circle. Instead, the nucleus is expressed as a series. Author

N68-23480*# Georgia Inst. of Tech., Atlanta.
APPLICATION OF GROUP AND TRANSFORMATION THEORY TO THE SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS Final Report
R. H. Martin, Jr., C. N. Driskell, Jr., and L. J. Gallaher May 1968 97 p refs
(Contract NAS8-20286)
(NASA-CR-61217) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This report is concerned with the application of transformation groups to the solution of systems of ordinary differential equations and, in particular, partial differential equations. These groups are Lie groups in the usual sense, but it is the transformation properties rather than the group structure that is used. The principal tool used here, referred to as Lie's theorem, gives a method for finding an integrating factor for a system of ordinary differential equations when the appropriate invariance group or groups can be found. Lie's theorem is extended to partial differential equations by considering a partial differential equation as a continuously infinite system of coupled ordinary differential equations. For a system of ordinary differential equations the integrating factor is a matrix. For a partial differential equation the integrating factor is a continuously infinite matrix. The proof of Lie's theorem and its use for partial differential equations depends on constructing an adequate theory of continuously infinite matrices; this is done here through the use of distributions or generalized functions. Author

N68-23492 North Carolina Univ., Chapel Hill.
ON BAYES SEQUENTIAL DESIGN OF EXPERIMENTS
Robert Edward Bohrer (Ph.D. Thesis) 1966 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-965

The formulation of problems in sequential design of experiments is defined and seen to be a generalization of the conventional sequential analysis formulation. Some results analogous to standard sequential analysis results are cited. The average saving gained by using sequential designs is assessed in a very special case to provide an example of the advantage of the method. Examples using the sequential-design formulation are analyzed. The examples concern the problems of detecting the presence of a target and of classifying unlabeled drugs in the most economical way. Dissert. Abstr.

N68-23549 Oregon State Univ., Corvallis.
EIGENFUNCTION EXPANSIONS FOR SELF-ADJOINT BILINEAR OPERATORS IN HILBERT SPACE
John Richard Phillips (Ph.D. Thesis) 1966 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-737

This thesis is concerned with certain nonlinear operators and the eigenfunctions and eigenvalues associated with them. The formal setting is in an abstract Hilbert space H. Properties analogous to those for self-adjoint linear operators are investigated. In particular, the existence of eigenvalues, the existence of a maximal orthonormal set of eigenelements, and an eigenfunction expansion for an induced quadratic operator. The theory for operators of this type requires more elaborate analysis than the corresponding theory for linear operators. However, new results are obtained and new questions are raised. The theory is applied to certain quadratic integral equations and a formal solution is presented. Finally, the concept of self-adjointness is extended to quadratic differential equations and more general nonlinear operators. Dissert. Abstr.

N68-23569 New York Univ., N. Y.
ON THE REFLECTION OF SOLUTIONS OF LINEAR PARTIAL DIFFERENTIAL EQUATIONS
Clyde Denson Hill (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-602

A general program is presented for the explicit construction of reflection formulas, analogous to the Schwarz reflection principle for harmonic functions, for solutions of elliptic and parabolic equations of the second order in any number of independent variables. The cases discussed in detail are those of parabolic equations in one and two space variables. This effects an extension to parabolic equations of a method for elliptic equations proposed by Garabedian. A fundamental solution for parabolic equations is introduced that differs in an essential way from the one usually considered. In terms of it an explicit representation of the solution of the noncharacteristic Cauchy problem for such a parabolic equation is derived. Dissert. Abstr.

N68-23623 Minnesota Univ., Minneapolis.
GENERALIZED ILSTOW AND COMPLEX WIENER INTEGRALS AND A RELATED INTEGRAL EQUATION
David Lee Skoug (Ph.D. Thesis) 1966 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-880

Let C[a,b] be the space of continuous functions x(t) defined on [a,b] and vanishing at t=a. Using the Wiener integral we define for M=0, 1, 2, ..., what we call the M Ilstow integral of a functional F(x) on C[a,b]. Given are necessary and sufficient conditions for a finite dimensional functional F(x) to be M Ilstow integrable. Counterexamples are presented which show that the set of M Ilstow integrable functionals is properly contained in the set of (M+1) Ilstow integrable functionals on C[a,b]. Also presented are counterexamples which show that M Feynman integrability does not imply (M+1) Feynman integrability. Dissert. Abstr.

N68-23626 California Univ., Los Angeles.
OPTIMUM QUANTIZING IN HYBRID COMPUTATION
Roger Charles Wood (Ph.D. Thesis) 1966 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-561

The quantization process is examined, in the specific context of hybrid computation, with the aim of improving the efficiency of that process. To this end, the problem space is partitioned into two classes, depending upon whether or not the signals to be quantized have significant intersample correlation. For signals whose samples are time-independent, the results of Widrow and Max are examined and it is shown that Widrow's pseudoindependence of signal and quantization noise cannot be extended to the case of the optimum (fixed-level) quantizer of Max. For signals whose samples possess sufficient time correlation, which includes most hybrid applications, it is shown that predictive quantizing techniques will yield significant savings in quantizer size. Dissert. Abstr.

N68-23675 Oregon State Univ., Corvallis.
ON TRIANGULATIONS OF FIXED POINTS IN THE PLANE
Frederick Wesley Weingarten, Jr. (Ph.D. Thesis) 1966 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-755

A theory of straight line triangulations of points in the plane is developed. A basic transformation is presented, and it is shown that any triangulation may be transformed into any other

triangulation which has the same boundary by a finite sequence of the basic transformations. The proof of the transformation theorem involves the presentation of an algorithm. Programs for processing triangulations of points are developed and coded in FORTRAN IV and in flow chart form. Dissert. Abstr.

N68-23712*# Missouri Univ., Columbia. Business and Public Administration Research Center.
RISK AVERSION AND BIDDING THEORY
D. L. Hanson and C. F. Menezes [1967] 41 p refs
(Grant NGR-26-004-012; AF-AFOSR-746-65)
(NASA-CR-94596) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Developed is a bidding model for competitive sealed tender selling markets that use the size of the payoff and the level of initial wealth for maximization of expected utility of wealth with utility a concave function of the wealth. Formal properties and economic interpretation of the model are used to develop a natural relationship between principle properties and certain tools and concepts of mathematical statistics as well as a theory of risk aversion. The conditions under which the model has a unique solution are developed, the hazard rate function is interpreted, and the expression determining the optimal bid is shown to have a straightforward behavior meaning. Author

N68-23782# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
A SIMPLIFIED FORMAT FOR THE MODEL ELIMINATION THEOREM-PROVING PROCEDURE
D. W. Loveland Dec. 1967 38 p refs
(Contract ARPA SD-146; Grant NSF GP-7064)
(AFOSR-68-0618; AD-667282)

The paper presents an alternate approach to the formulation of the Model Elimination proof procedure presented in another paper. By exploiting fully the ability to linearize the procedure format (isolating the format from a tree structure form) and by representing lemmas by clauses, the description of the Model Elimination procedure is greatly simplified. Author (TAB)

N68-23802# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
SEQUENTIAL BOOLEAN EQUATIONS
Shimon Even (Harvard Univ.) and Albert R. Meyer Mar. 1968 41 p refs
(Contract ARPA SD-146)
(AFOSR-68-0651; AD-667537)

The problem of solving sequential Boolean equations is shown to be equivalent to the problem of finding whether there exists a path on a labeled graph for every sequence of labels. Algorithms are given for testing whether a solution exists, and if a solution with a finite delay exists. In case of existence of solutions the algorithms provide them. Author (TAB)

N68-23810# Pennsylvania Univ., Philadelphia.
DIFFERENTIABLE ACTIONS OF HOMOTOPY SEVEN SPHERES, 2
D. Montgomery and C. T. Yang 4 Mar. 1968 19 p refs Supported in part by NSF
(Contract DA-31-124-ARO(D)-123)
(AROD-2056.20-M; AD-667377)

The paper presents a theorem which shows that there are exactly six unoriented homotopy 7-spheres not diffeomorphic to one another such that on each of them there is a free differentiable action of the circle group. Moreover, on any homotopy 7-sphere, if there exists a free differentiable action of the circle group, then there are infinitely many topologically distinct from one another. TAB

N68-23896# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ARITHMETICAL OPERATIONS OVER INTEGERS WITH ARBITRARY SIGNS IN A SYSTEM OF RESIDUE CLASSES AND THEIR CIRCUIT REALIZATION [ARYFMETYCHNI OPERATSIYI NAD TSILYMY CHYSLAMY DOVIL'NYKH ZNAKIV U SYSTEMI ZALYSHKOVYKH KLASIV TA IKH SKHEMNA REALIZATSIYA]
Yu. P. Sobornykov 15 Aug. 1967 21 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 2, 1966 p 17–26
(FTD-HT-23-580-67; AD-667639)

The paper considers a method of performing arithmetical operations of numbers with arbitrary signs in a nonexcessive, nonpositional number system of residue classes (SZK), as well as the structure of an arithmetical device realizing operations which are typical of SZK and problems of linear algebra. TAB

N68-23927*# Columbia Univ., N. Y. Operations Research Group.
A NOTE ON SEQUENTIAL SEARCH
Morton Klein 30 Aug. 1967 26 p refs Sponsored in part by NASA
Contract Nonr-266(55))
(NASA-CR-94611; TR-36; AD-667595) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Optimal distribution of search effort problems for certain kinds of moving targets are considered. It is known that they can be formulated by the use of appropriate Markovian decision models. Author (TAB)

N68-23965# Instituto de Energia Atomica, Sao Paulo (Brazil).
VECTORS, MATRICES, AND DETERMINANTS [VETORES, MATRIZES, ET DETERMINANTES]
Maximilian Emil Hehl Apr. 1967 58 p refs In PORTUGUESE *Its* Inform. No. 7

Beginning with the fundamentals of vectors, this work presents the classical concepts concerned with matrices and determinants. The topics presented include fundamental concepts of vectors and relative definitions, together with the numerical methods and programs for their basic operations; definitions of the principal types of matrices; basic operations with matrices including digital programs; a definition of a determinant of a matrix and its elements, and fundamental properties and methods for calculating the determinants; properties of a few special matrices; transposed, inverse, and adjunct matrices; and the determination of an inverse matrix by various numerical methods. The programs presented to illustrate these topics are written in Fortran II and were tested on an IBM 1620 computer. Transl. by R.N.A.

N68-23993 California Univ., Berkeley. Operations Research Center.
DECOMPOSITION PROGRAMMING AND ECONOMIC PLANNING
Stephen P. Bradley Jun. 1967 83 p refs
(Contracts DA-31-124-ARO(D)-311; Nonr-222(83); Grant NSF GP-7417)
(ORC-67-20; AROD-5307.31-M; AD-667245)

The class of mathematical programming problems whose range is in euclidian n-space but whose domain is an abstract space is considered. A duality theory is presented that relates the constrained maximization problem considered as a function of its right-hand side to the associated Lagrangian maximization problem considered as a function of the Lagrange multipliers. The analysis leads to useful computational procedures. Author (TAB)

N68-23997# RAND Corp., Santa Monica, Calif.
THE NUMERICAL SOLUTION OF NETWORK PROBLEMS USING THE OUT-OF-KILTER ALGORITHM
R. J. Clasen Mar. 1968 64 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5456-PR; AD-667528)

Network flow problems arise in the solution of transportation and scheduling problems. Divided into four substantially independent sections, this Memorandum: (1) reviews the types of problems that are representable as capacitated network problems; (2) explains (with diagrams) the out-of-kilter algorithm and techniques for implementing it on a computer; (3) describes modification of the algorithm to a two-phase algorithm; (4) presents a method for labeling the nodes by means of a scan list. Tentative conclusions are that the two-phase algorithm is undesirable, and that the labeling procedure shortens computer time at the cost of using more memory. Author (TAB)

N68-24018# Pennsylvania Univ., Philadelphia.
FREE DIFFERENTIABLE ACTIONS ON HOMOTOPY SPHERES Interim Technical Report
D. Montgomery and C. T. Yang 4 Mar. 1968 27 p refs Sponsored in part by NSF
(Contract DA-31-124-ARO(D)-123)
(AROD-2056.19-M; AD-667378)

Throughout this paper, G denotes the circle group SO(2) of rotations of the euclidean plance and Z_2 denotes the subgroup of G of order 2. R^n denotes the euclidean n-space, S^2 denotes the unit n-phere in R^{n+1}, and CP^n denotes the complex projective n-space, all having the usual differentiable structure. By a homotopy n-sphere, abbreviated by HS^n, we mean a closed differentiable n-manifold having the homotopy type of S^n; by a homotopy complex projective n-space, abbreviated by HCP^n, we mean a closed differentiable 2n-manifold having the homotopy type of CP^n. Author

N68-24049# Philco-Ford Corp., Blue Bell, Pa. Systems Sciences Lab.
COMPOUND DECISION PROCEDURES FOR PATTERN CLASSIFICATION Final Report, 1 Aug. 1965–30 Apr. 1967
Kenneth Abend (Ph.D. Thesis—Pennsylvania Univ.) Wright-Patterson AFB, Ohio AMRL Dec. 1967 108 p refs
(Contract AF 33(615)-2966)
(PR-345; AMRL-TR-67-10; AD-667570)

Compound decision theory is shown to be powerful as a general theoretical framework for pattern recognition, leading to nonparametric methods, methods of threshold adjustment, and methods for taking context into account. The finite-sample-size performance of the Fix-Hodges nearest-neighbor nonparametric classification procedure is derived for independent binary patterns. The optimum (Bayes) sequential compound decision procedure, for known distributions and dependent states of nature is derived. When the states of nature form a Markov chain, the procedure is recursive, easily implemented, and immediately applicable to the use of context. A similar procedure, in which a decision depends on previous observations only through the decision about the preceding state of nature, can (when the populations are not well separated) yield results significantly worse than a procedure that does not depend on previous observations at all. When the populations are well separated, however, an improvement almost equal to that of the optimum sequential rule is achieved. Author (TAB)

N68-24055*# Analytical Mechanics Associates, Westbury, N. Y.
PROPERTIES OF THE CONJUGATE GRADIENT AND DAVIDON METHODS, PART 5 Final Report
Geraldine E. Myers Apr. 1968 20 p refs
(Contract NAS9-4036)
(NASA-CR-92127; Rept.-68-8) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Two quadratically convergent gradient methods for minimizing an unconstrained function of several variables are examined. The heart of the Fletcher and Powell reformulation of Davidon's method is a variable H matrix. The eigenvalues and eigenvectors of this matrix for a quadratic function are explored, leading to a proof that the gradient vectors at each step are mutually orthogonal. From this is derived a geometric interpretation of the H matrix in terms of the projection of the gradient into a solution subspace. These properties are used to arrive at the main result, which states that, for a quadratic function, the direction vectors generated by the Davidon algorithm and the conjugate gradient algorithm of Hestenes and Stiefel are scalar multiples of each other, provided the initial step each takes is in the direction of steepest descent. Assuming no round-off and a perfect one-dimensional search, the methods will generate identical steps leading to the mininum. It is also shown that, for a quadratic function, the Davidon algorithm has a simplified version which searches in the same directions. Author

N68-24141*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPUTER PROGRAM FOR REVERSION OF THE CUMULATIVE BINOMIAL PROBABILITY DISTRIBUTION
Darl D. Bien Washington May 1968 13 p refs
(NASA-TM-X-1592) CFSTI: $3.00 CSCL 12A

A technique for reversion of the cumulative binomial probability distribution and an efficient and rapid computer program using the technique are presented. Reversion of the binomial series is useful in calculating the element success probability in a specified parallel system with redundancy which will yield the specified system success probability (reliability). The program is not limited to reliability problems but can also be used in a variety of scientific and engineering problems involving the reversion of the binomial series. Author

N68-24185# Ohio State Univ. Research Foundation, Columbus.
MEASURE THEORETICAL FOUNDATIONS OF SURFACE AREA THEORY, PART 1 Final Report, 13 Aug. 1965–30 Sep. 1967
Earl J. Mickle Oct. 1967 6 p refs
(Grants DA-ARO(D)-31-124-G589; DA-ARO(D)-31-124-G312)
(AROD-1685.27-M, Pt. 1; Rept.-3; AD-667371)

The study of the measure theoretical foundations of surface area has led to results that pertain to surface area theory and to results that pertain to measure theory itself. In particular, since the area of a surface is invariant under rigid motions, the measure theory results have been concerned with Haar measures. These results are concerned with the existence, uniqueness or both, of measures invariant under homeomorphisms from a locally compact Hausdorff space onto itself. Author (TAB)

N68-24187 Navy Underwater Sound Lab., New London, Conn. Digital Computing Branch.
SOLVING SYSTEMS OF LINEAR EQUATIONS BY USING THE GENERALIZED INVERSE
Marvin J. Goldstein 4 Mar. 1968 27 p refs
(USL-874; AD-667727)

The report proves that a particular vector function, defined on real n-space, is a least squares solution for any real m x n linear system of equations (Ax = b). Expressed in terms of the coefficient matrix A, the generalized inverse A prime of matrix A, and the vector b, the function is shown to be the complete solution of the system provided that a solution exists. The particular functional element A prime b of smallest Euclidean length is discussed with regard to its applications in solving systems of linear and nonlinear equations, in curve fitting, and in finding least squares estimates of linear regression coefficients. A program that computes A prime is described briefly. Author (TAB)

N68-24192# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
THE UNSOLVABILITY OF THE EQUIVALENCE PROBLEM FOR λ-FREE NONDETERMINISTIC GENERALIZED MACHINES
T. V. Griffiths Jan. 1968 14 p refs *Its* Phys. Sci. Res. Papers, No. 349
(AFCRL-68-0012; AD-667209)

We show that the equivalence problem for Lambda-free nondeterministic generalized machines is unsolvable and observe that this result implies the unsolvability of the equality problem for c-finite languages. Author (TAB)

N68-24204*# Connecticut Univ., Storrs. Dept. of Statistics.
ROBUSTNESS OF RELIABILITY PREDICTIONS FOR A SERIES SYSTEM OF IDENTICAL COMPONENTS
Clifford D. Leitao and Harry O. Posten May 1967 27 p refs
(Contract Nonr-3292(03))
(NASA-CR-94355; RR-29; AD-654720) CFSTI: $3.00 CSCL 12A

The present research investigates the robustness of reliability prediction procedures based on the assumption of an exponential failure distribution. A system of n independent identical components in series is considered and a maximal region of robustness, in terms of the shape parameter of the Weibull failure distribution (having mean identical to that of the assumed exponential distribution), is determined. This region of robustness has the property that within this region the use of the exponential assumption will produce a prediction error no larger than the specified level of robustness for the region. Regions are obtained for an unrestricted time period and a restricted time period in which the individual components have a minimum reliability rho (rho = .95, .99). Author (TAB)

N68-24259# General Electric Co., Schenectady, N. Y. Telecommunications and Information Processing Dept.
COMPLEX NUMBER NOTATION AND FINDING ROOTS OF QUADRATIC EQUATIONS, A BRIEF SURVEY
M. V. Farina Jul. 1967 28 p
(Rept.-67TIP02)

This report gives a brief non-rigorous discussion of complex number notation and finding roots of quadratic equations. The text proceeds from an explanation of how complex numbers arise and gives a definition for "i". Calculations involving complex numbers are illustrated. The quadratic equation is introduced; an explanation is given of the various ways that roots can be calculated. The concept of "reflected curves" is given as an aid in visualizing the location of imaginary roots. Author

N68-24260 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SOLUTIONS OF NONLINEAR PROBLEMS BY LEAST SQUARES METHOD ON THE GIER COMPUTER. PROCEDURE KWADRACIKI [ROZWIAZYWANIE PROBLEMOW NIELINIOWYCH METODA NAJMNIEJSZYCH KWADRATOW NA E.M.C. GIER. PROCEDURA KWADRACIKI]
Witold Grochulski and Wojciech Wojcik 1967 29 p refs In POLISH; ENGLISH summary
(IBJ-866/I/PL) CFSTI: $3.00

KWADRACIKI, an Algol procedure for solving optimization and minimization of nonlinear problems by the least squares method, is described. The procedure is written for use on the GIER computer. Algorithms, applications and results, and printouts are also presented. K.W.

N68-24314# Stanford Univ., Calif. Dept. of Statistics.
REPRESENTING FINITELY ADDITIVE INVARIANT PROBABILITIES
Richard A. Olshen 15 Mar. 1968 8 p refs
(Grant DA-ARO(D)-31-124-G726)
(AROD-2025.21-M; TR-21; AD-667369)

Hewitt and Savage have shown that finitely additive exchangeable probabilities on a product space are integral averages of power product probabilities. They prove this result as a corollary to their theorems on the countably additive case. This note adapts their technique to the study of more general invariant probabilities. From results of Farrell and Choquet and Feldman it is concluded that finitely additive invariant probabilities are averages of finitely additive ergodic probabilities. In a countably additive context it seems necessary to impose restrictions on the Borel field being studied and on the maps used to define invariance and ergodicity. Relaxing the assumptions of one type must be balanced by strengthening those of the other. Here, however, the field of sets can be arbitrary, and the maps are assumed only to be measurable. Rather than state a host of theorems which can be proved, one particular case is proved in detail. It is explained how the techniques can be applied to other problems. Several definitions of ergodicity are porposed and related to the one used. The final section contains a subjective probability interpretation of invariance and ergodicity. Author (TAB)

N68-24322*# Tulane Univ., New Orleans, La.
A STUDY OF FLUID AND STRUCTURAL BEHAVIOR UNDER LOW GRAVITY CONDITIONS Final Report
Victor J. Law [1967] 77 p refs
(Contract NAS8-21059)
(NASA-CR-61780) CFSTI: $3.00 CSCL 12A

A generalized method called Rotational Discrimination for nonlinear regression and equation solving is described. An adaptive method for system identification is then described for two types of situations; namely, time domain data or frequency domain data may be used. A method is also described for reducing certain types of time domain data into frequency form. Digital computer programs are listed and their usage is described for each of these procedures. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-23124# Weather Squadron (7th), Detachment 42, Kansas City, Mo.
LOW LEVEL THICKNESS CHARTS
Charles M. Umpenhour 18 Jan. 1968 12 p refs
(AD-666707)

The study discusses low level thickness charts from plotting and analysis procedures through some prognostic suggestion. Included in the study are aids to forecasting the type of precipitation, snowfall amounts and areas, temperature, thunderstorms, and gusty surface winds. Author (TAB)

N68-23203# RAND Corp., Santa Monica, Calif.
THE POLAR OCEANS AND WORLD CLIMATE
J. O. Fletcher Mar. 1968 61 p refs Presented at the Symp. on Beneficial Modifications of the Marine Environment, Washington, D. C., 11 Mar. 1968
(P-3801; AD-666653)

The following topics are discussed with the aid of numerous quantitative graphs depicting energy exchange between the ocean and the atmosphere and energy loss to space. (1) The physical reasons why the presence or absence of ice on the sea influences climate-forming processes. (2) Some questions associated with pack ice in the Arctic Ocean: How much does it vary. What causes these variations and how do they influence global climate. If the pack ice were removed, would it reform or would the Arctic Ocean remain an open sea. (3) Variations in the extent of sea ice around the Antarctic continent, how it varies, and how these variations may influence global climate. (4) Long-term changes of global climate and extent of pack ice. (5) Possibilities for artificially influencing large-scale climatic processes by influencing the extent of ice on the sea. Author (TAB)

N68-23204# Naval Postgraduate School, Monterey, Calif. Dept. of Meteorology and Oceanography.
ON THE INCLUSION OF LONG-WAVE RADIATION IN A TROPOSPHERIC NUMERICAL PREDICTION MODEL
Maurice B. Danard Jan. 1968 34 p refs
(NPS-51DD8011A; SR-1; AFCRL-68-0018; AD-666053)

A simple method of computing long-wave radiative cooling in the troposphere associated with water vapor is described. Radiation from ozone and carbon dioxide is not considered. However, influences of arbitrary vertical distributions of cloud and moisture are included. Average annual cooling rates along a meridional cross-section are calculated for a cloudless atmosphere. The results agree fairly well with the total radiative cooling (long- and short-wave) as given by Manabe and Moller (1961) except in the lower troposphere at low latitudes. Here short-wave absorption by water vapor is appreciable. Long-wave radiative cooling is also computed in a case of a developing cyclone for comparison with release of latent heat. The largest cooling occurs at cloud top and can be a significant fraction of the amount of energy released as latent heat in the upper troposphere. Destabilization of the cloud mass and subsequent increase in precipitation may be important in cyclone development. Author (TAB)

N68-23228# Travelers Research Center, Inc., Hartford, Conn.
SOLAR EVENT FORECAST AIDS Final Scientific Report, May 1965–Nov. 1967
Isadore Enger Mar. 1968 31 p refs
(Contract AF 19(628)-5129)
(Rept.-7668-297; AFCRL-68-0024; AD-666948)

The study describes the development of objective aids for predicting daily values of 10.7 cm flux measured at Ottawa. The step-wise regression technique was applied to 18 years of data to develop regression equations expressing flux 1, 2, 3, and 4 days ahead as functions of the past history of flux. The equations were used to compute frequency distributions of the forecast errors to be expected when the equations are applied under real-time conditions. Similar regression equations were also obtained for predicting flux 5, 6, 7, ..., 30 days ahead but no error distributions were computed. An attempt was made to improve the one- to four-day forecasts by including in the regression equations the recent history of Zurich sunspot numbers. The results were negative; flux alone did as well as flux and sunspots together. Two reports concerned with objective techniques for predicting the occurrence of solar flares were prepared previously under this contract. Abstracts of both are presented herein. Both the flare and flux techniques are being used routinely as forecast aids by the Solar Forecast Facility of the Air Weather Service. Author (TAB)

N68-23257# Army Electronics Labs., Fort Monmouth, N. J.
HARMONIC ANALYSIS OF PRECIPITATION
Marvin J. Lowenthal Nov. 1967 34 p refs
(ECOM-2893; AD-666772)

Periodicities in monthly precipitation over North America are investigated using harmonic analysis. The long term means are expressed by a trigonometric function (cosine or sine) with periods of 12, 6, and 4 months. Amplitudes and phase angles are examined with the goodness of fit determined by analyzing the residual variances after the application of one, two, and three harmonics. The variation of precipitation in the interior of North America may be satisfactorily expressed as a simple cosine curve with a summer maximum and an amplitude of about one inch. Adding the second and third harmonic reduces the residual variance to less than 20% in all but three small scattered areas. The physical reasoning behind this mathematical technique is not immediately evident since synoptic phenomena occurring at three-month intervals are not clear. Author (TAB)

N68-23358# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ROLE OF PRESSURE GRADIENT IN THE DEVELOPMENT OF A BREEZE [ROL' GRADIYENTA DAVLENIYA V RAZVITII BRIZA]
A. F. Dyubyuk and T. B. Seznev 17 Nov. 1967 15 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 7, 1962 p 11–18
(FTD-MT-24-305-67; AD-667075)

The problem of relationship between the pressure gradient and breeze development is explored. Formulas are presented describing each phase in the development of this phenomenon. Author

N68-23435# Ocean-Atomosphere Research Inst., Cambridge, Mass.
INERTIAL CHARACTERISTICS OF THE WINDS AND THEIR PREDICTIVE IMPLICATIONS FOR THE WATER MOVEMENTS OFF SOUTHWEST AFRICA Technical Report, 1 Jan.–31 Dec. 1967
Irving I. Schell 15 Jan. 1968 21 p refs
(Contract N00014-67-C-0334)
(OARI-1-68; AD-666631)

The report gives a summary of work done on correlations of the winds off the west coast of South Africa with the strength of the Benguela Current and associated upwelling as well as the northwestward penetration of the Agulhas Current water round the Cape from the Indian Ocean into the South Atlantic, from a consideration of surface temperatures during 1951-1961. Preliminary results obtained from this study are to be presented at the April 1-5 meeting of the joint American, British, German meteorological societies and the German Geophysical Society in Hamburg. Author (TAB)

N68-23592*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A TROPICAL CYCLONE DEVELOPMENT AS REVEALED BY NIMBUS 2 HIGH RESOLUTION INFRARED AND ESSA-3 TELEVISION DATA
Guenter Warnecke, Lewis J. Allison, Earl R. Kreins (USAF Environ. Tech. Appl. Center), and Larry M. McMillin (Allied Res. Assoc., Inc.) Jan. 1968 34 p refs Presented at 5th Tech. Conf. on Hurricanes and Tropical Meteorol., Caracas, 21 Nov. 1967
(NASA-TM-X-63197; X-622-68-39) CFSTI: HC $3.00/MF $0.65
CSCL 04B

Nimbus II high resolution infrared radiometer data, in combination with ESSA-3 photographs and the sparse conventional observations available from the central Pacific Ocean, were analyzed to determine the early stages of tropical storm development for the case of typhoon Marie 1966. The meteorological conditions in the area were found to satisfy the requirements commonly considered necessary for tropical storm development in that the sea surface temperature was above 28°C, a deep lower tropospheric moist layer existed, the surface flow was convergent, and the vertical wind shear was small. The mid-Pacific troughs present in both hemispheres and outlined by distinct cloud bands reached with their extremities into the development area. They were also associated with a pronounced upper tropospheric (200 mb) divergence which could mainly be inferred from the cirrus flow visible in the satellite observations and which persisted for a number of days over the region of storm development. This upper divergence seemed to play a major role in the initial development of the storm. Results prove the usefulness of high resolution infrared and television observations from satellites for the investigation of relatively small scale phenomena in tropical meteorology. Author

N68-23654# European Atomic Energy Community, Ispra (Italy).
EIGHTH METEOROLOGICAL YEARBOOK [8 ANNUARIO METEOROLOGICO]

G. Bollini and C. Gandino Mar. 1968 118 p refs In ITALIAN; ENGLISH summary
(EUR-3904.I)

After a short description of the methods for measuring and elaborating atmospheric phenomena, many tables and graphics for the meteorological year 1966 are reported. With the Observatory's data, temperature measurements at screen No. 4, 43 m lower, and wind measurements in the northern area of the Nuclear Research Center, are added. Author

N68-23661# Colorado State Univ., Fort Collins. Dept. of Atmospheric Sciences.
GLOBAL VIEW OF THE ORIGIN OF TROPICAL DISTURBANCES AND STORMS
William M. Gray Oct. 1967 111 p
(Grants NSF GF-177; ESSA-E-34-67(G))
(Rept.-114; PB-177660)

A global observational study of atmospheric conditions associated with tropical disturbance and storm development is presented. This study primarily uses upper-air-observations which have become available over the tropical oceans in the last decade. Climatological values of vertical stability, low-level wind, tropospheric vertical wind shear, and other parameters relative to the location and seasons of tropical distrubance and storm development are discussed. Individual storm data are also presented in summary form for over two hundred development cases (with over one thousand individual observation times), for three genesis areas in the Northern Hemisphere. Tropical disturbance and later storm development is viewed as primarily a result of large-scale Ekman or frictionally forced surface convergence (with resulting cumulus production and tropospheric heating), and a consequent inhibition of tropospheric ventilation by initially existing small vertical wind shear. PB

N68-23740# McGill Univ., Montreal (Quebec).
ALBERTA HAIL STUDIES, 1966
A. J. Chisholm, Marianne English, Walter Hitschfeld, Jerry Pell, and Norman H. Thyer May 1967 85 p refs Sponsored in part by Can. Meteorol. Serv.
(Contract F19628-67-C-0129)
(MW-49; AFCRL-67-0657; SR-2; AD-666934)

A new method is presented for evaluating double theodolite pibals, using all four theodolite angles to locate the most likely position of the balloon. The calculation may be done graphically, once a special chart has been compiled, so straightforward calculations of wind are possible without use of a computer. Pell: Although some storms may generate hail continuously, in the manner of the Wokingham storm of Browning and Ludlam, there are cases of storms which produce intermittent hailswaths disrupted by patches of only rain. Closely related to the problem of swath continuity is that of continuity of hailfall at a point. Again, reports have been recorded which indicate that frequently hail falls in bursts separated by periods of either rain or no precipitation at all. Chisholm: A study of radar echo maxima in two Alberta hailstorms has shown that the storms consisted of several storm families, each containing small intense radar echo cores or cells. These cells developed preferentially on the right flank of the family, moving across the track of the family at an acute angle to dissipate near the left flank; identifiable lifetimes of the cells were 20-30 minutes. There appeared to be a cycle of development of the cells, which had a considerable effect on the overall storm-family velocity. Author (TAB)

N68-23741# McGill Univ., Montreal (Quebec).
A NEW METHOD OF DOUBLE THEODOLITE PIBAL EVALUATION
Norman H. Thyer *In its* Alberta Hail Studies, 1966 May 1967 p 3-27 refs (See N68-23740 13-20)

A method is presented for evaluating double theodolite pibals, using all four theodolite angles to locate the most likely position of the balloon. The calculation may be done graphically, once a special chart has been compiled, and so straightforward calculations of wind are possible without use of a computer. Author

N68-23742# McGill Univ., Montreal (Quebec).
CONTINUITY IN HAIL PRODUCTION AND SWATHS. A REVIEW
Jerry Pell *In its* Alberta Hail Studies, 1966 May 1967 p 29-53 refs (See N68-23740 13-20)

The Wokingham storm study made by Browning and Ludlam postulated a steady-state supercell which would generate hail continuously along the storm trajectory. Although such storms may very well exist, or as Browning and Fujita point out, some storms may attain a quasi-steady state for certain portions of their lifetimes, there are documented cases of storms which produce intermittent hailswaths, disrupted by patches of only rain. In particular, we may mention the work of Carte in both Africa and Alberta, and of McBride in Alberta. Closely related to the problem of swath continuity is that of continuity of hailfall at a point. Again, reliable reports have been received from observers who indicate that frequently hail may fall in bursts, separated by periods of either rain or no precipitation at all. Author

N68-23743# McGill Univ., Montreal (Quebec).
SMALL SCALE RADAR STRUCTURE OF ALBERTA HAILSTORMS
A. J. Chisholm *In its* Alberta Hail Studies, 1966 May 1967 p 57-81 refs (See N68-23740 13-20)

A study of radar echo maxima in two Alberta hailstorms has shown that the storms consisted of several storm families, each containing small intense radar echo cores or cells. These cells developed preferentially on the right flank of the family, moving across the track of the family at an acute angle to dissipate near the left flank; identifiable lifetimes of the cells were 20-30 minutes. There appeared to be a cycle of development of the cells, which had a considerable effect on the overall storm-family velocity. Author

N68-23753# Naval Research Lab., Washington, D. C. Chemical Oceanography Branch.
THE INFLUENCE OF MONOMOLECULAR SURFACE FILMS ON THE PRODUCTION OF CONDENSATION NUCLEI FROM BUBBLED SEA WATER Interim Report
William D. Garrett 29 Feb. 1968 29 p refs
(NRL-6672; AD-667462)

Salt condensation nuclei were produced in large quantities (100,000 particles per cu cm) from bubbled sea water and sodium chloride solutions. The addition of pure and mixed insoluble monomolecular films to the sea-water surface increased the concentration of salt nuclei by as much as threefold. The greatest increases were caused by the binary monolayers, which were synergistic in their behavior. No increases in nuclei count resulted when monolayers were spread onto the surface of aqueous systems which did not contain surface-active foam-forming materials. The increase in the number of salt particles measured is not related to a surface-chemical modification of either the sea-water droplets or the surface of the salt particles but is a consequence of the alteration of the mechanics of the bubble-bursting process. The insoluble film decreases the degree of foaming at the sea-water surface and enhances the immediate breaking of small bubbles. This leads to a greater rate of surface fragmentation of the air/water interface. The meteorological and oceanographic implications of these data are discussed. Author (TAB)

N68-23795 Weather Wing (1st), San Francisco, Calif.
EXTREME DAILY RAINFALL AMOUNTS IN THE REPUBLIC OF VIETNAM Final Meteorological Report
Gary D. Atkinson Mar. 1968 34 p refs *Its* Tech. Study 16
(AD-667551)

The double exponential distribution is applied to extreme daily rainfall amounts in the Republic of Vietnam. With few exceptions, this distribution fits the annual extremes very well and is used to determine expected daily extremes for return periods of 5 to 100 years. The expected extremes for a 100 year return period range from 6 to 8 inches in the Southern lowlands to over 20 inches in the mountainous regions in the north. The double exponential distribution also gives a fair fit to the monthly extremes during the wetter months. The seasonal distribution and physical causes of the annual daily extremes are discussed. Along the east coast and northern mountains, the highest daily rainfall amount each year generally occurs between mid-September and mid-December corresponding to the maximum frequency of tropical cyclones during this period. Over the remainder of the country, the annual extremes are caused by heavy thunderstorms and can occur any time during the southwest monsoon or transition months (April through November). Author (TAB)

N68-23881 American Meteorological Society, Boston, Mass.
PRELIMINARY RESULTS OF A STUDY OF STEADY PRECIPITATION, BASED ON DATA OF A DENSE RAIN-GAGE NETWORK [PREDVARITEL'NYE REZUL'TATY ISSLEDOVANIIA OBLOZHNYKH OSADKOV PO DANNYM GUSTOI OSADKOMERNOI SETI]
M. P. Leonov Bedford, Mass. AFCRL Jan. 1968 34 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 47, 1965 p 30–50
(Contract AF 19(628)-3880)
(T-R-553; AD-667407)

A method of investigation is presented and the properties of fields of steady precipitation are studied on the basis of the observations of a dense rain-gage network at the weather experiment range (WER) for six winter months of 1960-1962. The study deals with steady precipitation over the entire WER, the synoptic processes producing it, the optimum areas for averaging, the horizontal inhomogeneity of precipitation distribution on charts of semidiurnal and diurnal precipitation, and methods of smoothing the latter. The results should be applicable to studies of the physics of precipitation formation, evaluation of the effectiveness of experiments in seeding raining clouds, and computation of the amount of steady precipitation for any given area. Author (TAB)

N68-23883 American Meteorological Society, Boston, Mass.
INTENSIFICATION OF PRECIPITATION OVER A WEATHER EXPERIMENT RANGE IN THE WINTER OF 1963–1964 [INTENSIFIKATSIIA OSADKOV NAD EKSPERIMENTAL' NYM METEOROLOGICHESKIM POLIGONOM ZIMOI 1963–1964 G]
M. P. Leonov and T. D. Nerobeeva Bedford, Mass. AFCRL Dec. 1967 20 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 47, 1965 p 88–89
(Contract AF 19(628)-3880)
(T-R-507; AD-667402)

The authors present their results from 17 experiments on the intensification of natural precipitation conducted over a weather experiment range in the winter of 1963-1964. The positive effect of seeding is confirmed by the data of a precipitation-gauge network and by radar observations. Author (TAB)

N68-23891 American Meteorological Society, Boston, Mass.
MODIFICATION OF THE CLOUD DROPLET SPECTRUM BY THE INTRODUCTION OF PARTICLES THAT STRONGLY ABSORB SOLAR RADIATION [O MODIFIKATSII SPEKTRA OBLACHNYKH KAPEL'S POMOSHCH'IU VVEDENIIA SIL'NO POGLOSHCHAIUSHCHIKH SOLNECHNUIU RADIATSIIU CHASTITS]
M. V. Bulkov Bedford, Mass. AFCRL Jan. 1968 22 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 47, 1965 p 3–16
(Contract AF 19(628)-3880)
(T-R-550; AD-667405)

This paper deals with a process of cloud droplet growth by repeated distillation in a mixture of cloud droplets and droplets containing a reagent that intensifies the absorption of short-wave radiation by these droplets. It is shown that a substantial growth of the cloud droplets occurs several tens of hours after modification, given favorable assumptions concerning the details of the process. The temperature increase inside the cloud due to the absorption of short-wave radiation is also determined. Before a substantial change in the droplet spectrum is achieved, the temperature increase results in the evaporation of a large part of the clouds moisture. Author (TAB)

N68-23898 American Meteorological Society, Boston, Mass.
THE STORED WATER OF STRATUS AND STRATOCUMULUS CLOUDS OVER THE UKRAINE IN THE COLD HALF OF THE YEAR [VODOZAPASY SLOISTYKH I SLOISTO-KUCHEVYKH OBLAKOV V KHOLODNOE POLUGODIE NAD UKRAINOI] POLUGODIE NAD UKRAINOI]
I. P. Polovina Bedford, Mass. AFCRL Jan. 1968 17 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 47, 1965 p 69–78
(Contract AF 19(628)-3880)
(T-R-555; AD-667409)

The stored water of St-Sc cloud masses is calculated on the basis of their lifetime, thickness, rate of transport, and average water content. The amount of precipitation that can be expected from these clouds is calculated on the assumption that the stored water will be completely precipitated. Author (TAB)

N68-23899 American Meteorological Society, Boston, Mass.
SOME CHARACTERISTICS OF RADIATION IN FOG [NEKOTORYE RADIATSIONNYE KHARAKTERISTIKI V TUMANE]
I. V. Koshelenko Bedford, Mass. AFCRL Jan. 1968 15 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 47, 1965 p 22–29
(Contract AF 19(628)-3880)
(T-R-552; AD-667406)

Data are presented on the radiation balance and total radiation in fog at ground level, at the top of the fog layer, and within the fog. The mean attenuation factors of long-wave and short-wave radiation in a fog layer are calculated on the basis of these data. Author (TAB)

N68-23908 American Meteorological Society, Boston, Mass.
THE EVOLUTION OF STRATUS CLOUDS IN THE SURFACE BOUNDARY LAYER OF THE ATMOSPHERE [K EVOLIUTSII SLOISTOI OBLACHNOSTI V PRIZEMNOM SLOE ATMOSFERY]
Iu. V. Shulepov Bedford, Mass. AFCRL Dec. 1967 17 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 47, 1965 p 13–20
(Contract AF 19(628)-3880)
(T-R-557; AD-667411)

The evolution of stratus clouds, whose base is in the surface boundary layer of the atmosphere, is investigated. Formulas are derived that describe the displacement of the base of stratus clouds during a brief time interval (t less than or equal to 10 to 20 min). Author (TAB)

N68-23935*# Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.

RADAR INVESTIGATION OF CLEAR-AIR TURBULENCE

Kenneth R. Hardy *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 16 p refs (See N68-23931 13-34) CSCL 04B

Ultrasensitive radar regularly detect echoes in the clear atmosphere. The echoes are caused by insects and birds or by scattering from regions of the atmosphere where the fluctuations in refractive index are large. Thin elevated layers and the tropopause have been detected by virtue of scattering from refractive index variations in clear air. The relationship between these clear air radar echoes and turbulence is discussed. The radar experiments during which aircraft probed the atmosphere in search of clear air turbulence are described. It has been found that all regions of clear air radar echoes above 6 km proved with the aircraft were turbulent. Author

N68-23944# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.

ESTIMATING THE DATE OF ONSET OF THE RAINY SEASON IN SOUTHERN SOUTH VIETNAM

Iver A. Lund *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 26 p refs (See N68-23931 13-34)

Prediction equations for estimating the beginning of the rainy season in southern South Vietnam are developed, and their application in the preparation of experimental extended range predictions of the 1967 rainy season's onset is discussed. S.C.W.

N68-23951# Wisconsin Univ., Madison. Dept. of Meteorology.

SUMMERTIME RADIATION BALANCE AND ENERGY BUDGET OF THE CANADIAN TUNDRA

William F. Ahrnsbrak Jan. 1968 58 p refs
(Contract Nonr-1202(07))
(TR-37; AD-667488)

As a step toward understanding the interrelationships between landform, vegetation, and climate of the Canadian tundra, summertime radiation balance and energy budget data obtained during July and August, 1966, at three locations in the district of Keewatin, N.W.T., are presented. Comparisons are made between these findings and estimates from other authors global and hemispheric radiation balance studies and also with energy budget studies of other investigators at Resolute Bay, N.W.T., and at Point Barrow, Alaska. The climate is shown to be one in which latitudinal and seasonal differences account for most of the variation. While during July the storage of heat in the soil accounts for fifteen percent of the energy budget, during the rest of the snow-free season net radiation is nearly balanced by transfer of sensible heat to the atmosphere. Author (TAB)

N68-23952# Weather Squadron (12th), Detachment 14, Selfridge AFB, Mich.

MORNING VISIBILITY STUDY FOR SELFRIDGE AFB, MICHIGAN

Stephen T. Hemenway Nov. 1967 12 p
(AD-667215)

The study was initiated to develop an objective method of forecasting IFR morning visibility (less than three miles) occurrences at Selfridge AFB, Michigan. Several weather parameters were examined in a search for possible predictors. Some correlation with the later occurrence of IFR visibility was noted between the following parameters, each recorded three hours before sunrise: temperature-dew point spread, wind speed, visibility, and geostrophic wind direction. Two diagrams are provided which are useful in objectively forecasting morning visibility. Author (TAB)

N68-23996# California Univ., Los Angeles. Dept. of Meteorology.

OBSERVATIONS OF STRATOSPHERIC CLEAR-AIR TURBULENCE AND MOUNTAIN WAVES OVER THE SIERRA NEVADA MOUNTAINS: AN ANALYSIS OF THE U-2 FLIGHTS OF 13–14 MAY, 1964 Final Report, 14 Jun. 1964–14 Sep. 1966

Roger A. Helvey Dec. 1967 93 p
(Contract AF 19(628)-4146)
(AFCRL-68-0001; AD-667222)

Data obtained from a specially-instrumented U-2 aircraft have been used to relate clear-air turbulence with mountain wave structure, observed during two research flights in the stratosphere over the Sierra Nevada Mountains on 13 and 14 May, 1964. The several cases of severe turbulence encountered took place in regions immediately downstream of wave troughs, in area of decreased static stability and slower wind speeds associated with the prevailing upwind tilt of the waves. An expression for the Richardson number is obtained which incorporates modifications imposed upon flow through stationary disturbances such as mountain waves. Author (TAB)

N68-24020 Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.

CLEAR AIR TURBULENCE: A BIBLIOGRAPHY, 1950–1967 Final Report

Dorothy E. Bulford Mar. 1968 82 p refs
(NA-68-17; AD-667731)

Clear air turbulence encounters can occur unexpectedly without any visual evidence or warning. As operations of higher altitude aircraft increase, the phenomenon is encountered more often. Clear air turbulence is defined as all turbulence in the free atmosphere of interest in aerospace operations that is not in or adjacent to visible convective activity (this includes turbulence found in cirrus clouds not in or adjacent to visible convective activity). This bibliography consists of 578 references to technical reports, articles in periodicals, and books published during the past 17 years. References about other forms of turbulence such as that occurring with storms and airplane wake vortices are not included. Author (TAB)

N68-24028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

REVISED UPPER-AIR WIND DATA FOR WALLOPS ISLAND BASED ON SERIALLY COMPLETED DATA FOR THE YEARS 1956 TO 1964

James A. Cochrane, Robert M. Henry, and William L. Weaver May 1968 101 p refs
(NASA-TN-D-4570) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Estimates of fundamental statistical parameters describing the velocity distribution of upper-air winds at Wallops Island were computed from a nine-calendar-year sample of rawinsonde observations collected four times daily. Because sufficient rawinsonde data were not available directly from Wallops Island, the sample consisted of rawinsonde data collected at U.S. Weather Bureau stations at Norfolk, Va., and Washington, D.C. The following parameters are tabulated for monthly and annual periods: means and standard deviations of the east-to-west and south-to-north components of wind velocity, and correlation coefficients (interlevel, intralevel, crosslevel, and time-lag correlations). The tabulated parameters are sufficient to define the vector normal distribution, and several methods of computing wind-speed and wind-direction probabilities by using this distribution model are summarized. A special problem arises when wind-speed and wind-direction probabilities for individual calendar days are computed by using parameter values tabulated for calendar-month periods; that is, a significant sampling error is introduced (especially for single calendar days falling at the beginning or end of a calendar month). To overcome this problem, a method of interpolating the calendar-month averages of the parameters is suggested. Author

N68-24033 Weather Wing (1st), San Francisco, Calif. Scientific Services.
PRESSURE DATA FOR STATIONS IN THAILAND AND SOUTH VIETNAM
Gordon K. T. Ing Feb. 1968 43 p refs *Its* Tech. Study 15
(AD-667550)

The study illustrates the computations of forecast altimeter settings and various pressure altitude values for stations in Southeast Asia using mean diurnal pressure curves. Appendix I contains diurnal pressure curves for 7 stations in Thailand and 12 stations in South Vietnam. Appendix II presents the data from Appendix I rearranged to list pressure values by month.
Author (TAB)

N68-24037 Weather Squadron (20th), San Francisco, Calif. 96525 Scientific Services.
CASE STUDIES OF SPRING AND SUMMER SEA STRATUS AT KUNSAN AIR BASE, KOREA
William B. Blankenship, Kong Sam Pak, and George Taniguchi Mar. 1968 35 p refs *Its* Tech. Study 17
(AD-667532)

Spring and summer sea stratus is a major forecasting problem at Kunsan AB. Stratus moves in rapidly from the sea quite often without warning and causes below VFR conditions at Kunsan lasting from a few hours to several days, at times bringing ceilings as low as 100 feet. Case studies of 1964 spring and summer stratus occurrences were made and from these, ideal synoptic situations for occurrences were determined. Formation of sea stratus seems to be well correlated with frontal passages. However, approaches and passages of fronts merely trigger sea stratus formation. Principal causes are the existence of strong cold or war air advection near the frontal boundaries. This can result in ceiling and visibility as low as WOX 1/16 due to advection of sea stratus or fog from offshore inlands over the station with the mixing of cold and warm air occurring over the Yellow Sea. Author (TAB)

N68-24140# American Meteorological Society, Boston, Mass.
FREQUENCY OF THICK CONVECTIVE CLOUDS OVER THE UKRAINE [POYTORIAEMOST' MOSHCHNOI KONVEKTIVNOI OBLACHNOSTI NAD UKRAINOI]
G. F. Prikhot'ko and Z. M. Iashovskaia Bedford, Mass. AFCRL Jan. 1968 8 p Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Gidrometeorol. (Kiev), no. 47, 1965 p 65–68
(Contract AF 19(628)-3880)
(T-R-554; AD-667408)

Data are given on the frequency of Cu cong and Cb of 5/10 or more sky cover over the Ukraine in summer. They are based on observations made six times daily at 103 weather stations.
Author (TAB)

N68-24153# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
AN INVESTIGATION OF THE STRUCTURE OF TURBULENCE OVER WATER SURFACE WAVES Progress Report
Donald J. Portman and Kenneth L. Davidson Mar. 1968 41 p refs
(Contract N00014-67-A-0181-0005)
(Rept.-08849-1-P; AD-667739)

A hot-wire anemometer system, a fast response resistance wire thermometer and a thermocouple circuit were used in an attempt to measure the structure of turbulence, the turbulent fluxes of heat and momentum and the mean vertical temperature difference over ocean waves. To study data reliability (1) the recorded information was converted to voltage analogs and recorded on a paper chart and (2) spectral analyses were made for all channels of information for a representative six minute interval. It was found that a high noise level was present in all recordings and that it could be accounted for by voltage and frequency fluctuations in the power supplied for the magnetic tape recorder. The noise level masked the temperature measurement outputs which, apparently, were very small because of the nearly neutral thermal stratification during the experiments. On the basis of the preliminary analyses it appears that meaningful velocity spectra and cross spectra for frequencies less than 1.5 Hz may be computed from the recordings; higher frequency information is probably obscured by the high noise level. Author (TAB)

N68-24157 American Meteorological Society, Boston, Mass.
DISSIPATION OF STRATUS CLOUDS IN A TURBULENT ATMOSPHERE [DISSIPATSIIA SLOISTOI OBLACHNOSTI V TURBULIZOVANNOI ATMOSFERE]
Iu. V. Shulepov and M. V. Buikov Jan. 1968 18 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorol. Inst. (Kiev), no. 48, 1965 p 3–12
(Contract AF 19(628)-3880)
(T-R-556; AD-667410)

The report contains the horizontal dissipation of a spatially homogeneous stratus cloud in a turbulent atmosphere, in which isothermy, an inversion in the supracloud layer, and downdrafts are present; the time required for total dissipation of the cloud is computed. Author (TAB)

N68-24174# Aerospace Corp., El Segundo, Calif. Technical Operations.
REMOTE SENSING OF RAIN BY RADAR, OCTOBER 1966–APRIL 1967
Richard L. Mitchell Jan. 1968 40 p refs
(Contract F04695-67-C-0158)
(TR-0158(3525-09)-1; SAMSO-TR-68-115; AD-667194)

Attenuation by rain imposes severe limitations on short-wavelength meteorological radars investigating rain. This is true whether the radar is ground based and located within the rain medium or remote from it. This paper analyzes the combined effects of scattering and attenuation for remotely located rain radars on such quantities as sensitivity to rainfall rate, measurement of rainfall rate distribution in range for short-pulse radars, clutter, and discrimination with a ground or sea background. The normalized radar cross section is derived as a function of wavelength and rainfall rate for two different rain models, as a convenient means of comparison. It is concluded that the one-way attenuation through the rain medium must be less than a few decibels; otherwise the radar will not be sensitive to rainfall rate. This result is unaffected by the choice of rain model. Author (TAB)

N68-24203# American Meteorological Society, Boston, Mass.
RADAR ANALYSIS OF CLOUD AND PRECIPITATION FIELDS [ANALIZ POLEI OBLACHNOSTI I OSADKOV PO RADIOLOKATSIONNYM NABLIUDENIIAM]
B. Sh. Divinskaia Bedford, Mass. AFCRL Dec. 1967 34 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 173, 1965 p 34–52
(Contract AF 19(628)-3880)
(T-R-537; AD-667404)

Some radar characteristics of cloud and precipitation fields and their connection with meteorological conditions and the synoptic situation are examined. The possibility of using radar observations to construct charts of the height of a cloud field and vertical cross sections through clouds is indicated. Author (TAB)

N68-24207# American Meteorological Society, Boston, Mass.
SOME RESULTS OF RADAR INVESTIGATIONS OF THE VERTICAL STRUCTURE OF SHOWERS AND THUNDERSTORMS [NEKOTORYE REZUL'TATY RADIOLOKATSIONNYKH ISSLEDOVANII VERTIKAL'NOI STRUKTURY LIVNEI I GROZ]
E. M. Sal'man and K. S. Zhupakhin Bedford, Mass. AFCRL Dec. 1967 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 159, 1964 p 59–64
(Contract AF 19(628)-3880)
(T-R-532; AD-667403)

The general laws of the vertical structure of showers and thunderstorms, investigated by radar during the summer of 1962, are examined. Author (TAB)

N68-24217# American Meteorological Society, Boston, Mass.
PROPERTIES AND MEANS OF COMPUTING THE WIGNER COEFFICIENTS AND 6J COEFFICIENTS [O SVOISTVAKH I SPOSOBAKH VYCHISLENIIA KOEFFITSIENTOV VIGNERA I 6J-KOEFFITSIENTOV]
A. A. Bandzaitis, K. P. Zhukauskas, A. Iu. Matulis, and A. P. Iutsis Bedford, Mass. AFCRL Dec. 1967 7 p refs Transl. into ENGLISH from Tr. Akad. Nauk SSSR, Ser. Mater. (USSR), v. 2, no. 1, 1964 p 108–112 Presented at Acad. of Sci. Conf. on Spectry., Minsk, 5–11 Jul. 1963
(Contract AF 19(628)-3880)
(T-R-616; AD-667419)

The Wigner coefficient in the form given by Regge (Nuovo Cimento v10 p544 1958) and the 6j coefficient as given by Racah (Phys. Rev. v62 p438 1942) were set up for computer calculation. TAB

N68-24252# Litton Systems, Inc., Monterey, Calif. Mellonics Systems Development Div.
EXTRACTING DIGITAL HISTORICAL WEATHER FIELDS FROM U. S. FLEET NUMERICAL WEATHER FACILITY FILES Final Report
N. M. Stevenson and W. C. Woodworth Mar. 1968 29 p refs
(Contract E-166-67(N))

Hemispherical fields in digital form were extracted from the U.S. Fleet Numerical Weather Facility (FNWF) in Monterey, California; and simultaneously converted to the ESSA Weather Bureau National Meteorological Center (NMC) grid format. Observations were made at 000Z and 1200Z for heights, temperatures, and humidities at pressure surfaces of 1000, 850, 700, 500, and 300 millibar levels between November 1, 1961, and January 31, 1968. The differences between the NMC and FNWF grids in both number of points stored and the format of the storage word are significant and costly in programming time and conversion to various computer types, and standardization efforts are recommended. Tape format and codes for converted FNWF history fields are presented, along with the tape inventory of both converted grid fields and missing grid fields. The program flow diagram, FNWF hemispherical numerical grid, and FNWF atmospheric program descriptions are included; as are analyses of randomly distributed data and dewpoint depression. M.W.R.

N68-24318# American Meteorological Society, Boston, Mass.
SOME RESULTS OF TESTS ON THUNDERSTORM DETECTORS WITH A SMALL RANGE OF COVERAGE [NEKOTORYE REZUL'TATY ISPYTANII GROZOREGISTRATOROV S MALYM RADIUSOM DEISTVIIA]
K. A. Semenov Bedford, Mass. AFCRL Jan. 1968 17 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 59–67
(Contract AF 19(628)-3880)
(T-R-571; AD-667417)

Experimental data on thunderstorm discharges recorded within a radius of 10-20 km by instruments with a variety of designs are compared and analyzed in the present paper. Author (TAB)

N68-24323# Emmanuel Coll., Boston, Mass. Oriental Science Library.
ACTA METEOROLOGICA SINICA TRANSLATED TITLES AND ABSTRACTS FROM VOLUME 27 (1956) THROUGH VOLUME 35 (1965)
N. H. Ng Bedford, Mass. AFCRL Dec. 1967 155 p refs
(Contract AF 19(628)-5073)
(Emm-67-167; AD-667520)

The report contains some 360 translated abstracts of articles and titles of current research in all fields of meteorology. The translated abstracts and titles are grouped chronologically under appropriate subjects divided into 22 chapters: (1) atmospheric dynamics and thermodynamics; (2) boundary layer meteorology, turbulence, local winds; (3) climatology (particular places), climatic fluctuations; (4) cloud physics and dynamics; (5) convection, heat transfer, vertical motion; (6) drought and flood, rainfall distributions; (7) general circulation; (8) long-range forecasting; (9) meso- and micrometeorology, agricultural meteorology, soil characteristics; (10) meteorological measurements and observations; (11) numerical forecasting (models and bases for); (12) orography and topographic effects; (13) radiation (solar, terrestrial; absorption, emission), solar-terrestrial effects; (14) radio and radar meteorology; (15) stratospheric and upper atmospheric circulation features; (16) synoptic analysis and forecasting, local forecasting; (17) synoptic climatology; (18) thunderstorms, hail, atmospheric electricity; (19) typhoons, tropical and subtropical meteorology, monsoons; (20) water vapor, evaporation, hydrologic cycle; (21) weather modification, cloud seeding; (22) miscellaneous. The monograph concludes with two author indexes, one in English appearing alphabetically and the other in Chinese arranged according to the number of strokes. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-23318*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DESCRIPTION OF AN ANALYTIC METHOD FOR THE DETERMINATION OF SPACECRAFT WINDOW-INDUCED NAVIGATION SIGHTING ERRORS
Kenneth C. White and Burnett L. Gadeberg 21 Feb. 1968 15 p refs Presented at Natl. Space Meeting of Navigation Engr., Cocoa Beach, Fla., 20–21 Feb. 1968
(NASA-TM-X-61075) CFSTI: HC$3.00/MF$0.65 CSCL 17G

Navigation measurements made through a spacecraft window with an optical instrument are subject to window-induced errors. The primary sources of these errors are nonflat window surfaces, nonparallel window surfaces, and window surfaces deformed due to pressure loading. Another source of measurement error is the index of refraction difference between the air inside the spacecraft and the space vacuum outside. An analytic method for the determination of these window-induced errors was developed. Given the spacecraft and window configuration: (1) Window surface pressure deformations are determined either analytically or experimentally; (2) Window surface anomalies of manufacture are obtained experimentally; (3) Pressure deformations and anomalies of manufacture are used to obtain a math model of the window surface shapes; and (4) Light rays are traced through the window to determine the errors. The method has been applied to the analysis of errors associated with a Gemini window and the results compared with experimental data. The results agree quite well indicating the analytic method does permit accurate prediction of window-induced navigation measurement errors. Author

N68-23377*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF MAXIMUM LIKELIHOOD TECHNIQUES TO THE DESIGN OF OPTIMUM STAR TRACKERS
Edwin C. Foudriat Washington May 1968 28 p refs
(NASA-TN-D-4549) CFSTI: HC$3.00/MF$0.65 CSCL 17G

An analytical method was developed for the design of optimum star trackers. In the method both the measurement procedure and the measurement processing—the estimation of the star parameters from the measurement samples—are optimized. The method for measurement processing is based upon the use of maximum likelihood techniques. The equations to be satisfied for estimation of the position and intensity of a star are given with the assumption that the photoelectrons leaving the cathode obey Poisson statistics. With the properties of the maximum likelihood method and the Cramér–Rao inequality, a technique is developed for optimization of the measurement procedure. General equations are derived for the optimum measurement position on the cathode. The procedure is applied to the design of a slit-type star tracker where it is desired to determine the x position of a star image with a Gaussian intensity distribution. The results indicate the star-tracker slit width should be based upon star image size and be independent of star-to-background intensity ratio. The measurement procedure indicates sample should be made along the limb of the star image.
Author

N68-23973# Technisch Documentatie en Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).
SECOND REPORT ON OMEGA, DIFFERENTIAL OMEGA AND O.P.L.E. FUTURE SEA-TRANSPORT, AIR-TRANSPORT AND METEOROLOGICAL PREDICTION-REQUIREMENTS
H. J. Bos Apr. 1968 22 p refs
(TDCK-90192) CFSTI: HC$3.00/MF$0.65

This report comprises descriptions of the development of OMEGA and differential OMEGA and the possible application of the OPLE experiment for meteorological purposes. A complete review is given of error elimination and its problem solving in shipboard operation, as well as of the problems in airborne operation, i.e.: oscillator inaccuracy, transmitter frequency error, propagation variation, ambiguity interval, noise, and specific lane-identification error.
Author

N68-24159# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROLLING THE MOTION OF AN OBJECT BY NEWTONMETER READINGS [OB UPRAVLENII DVIZHENIYEM OB"YEKTA PO POKAZANIYAM N'YUTONOMETROV]
V. D. Andreyev and I. V. Novozhilov 13 Sep. 1967 17 p refs Transl. into ENGLISH from Inzh. Zh. Mekhan. Tverd. Tela (Moscow), no. 2, 1966 p 3–10
(FTD-MT-24-166-67; AD-667706)

There is considered motion control of center of masses of an object directly by newtonmeter readings, without determination of coordinates of object. There is derived and analyzed motion control of object near a programmed trajectory. There is established generality of the examined problem with problems investigated before.
TAB

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-23061# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
A METHOD OF THERMAL CALCULATIONS OF A TUBULAR FUEL ELEMENT WITH SMOOTH OR FINNED SURFACES FOR A GAS COOLED HEAVY WATER REACTOR [METODIKA TEPELNEHO VYPOCTU TRUBKOVEHO PALIVOVEHO CLANKU S HLADKYM NEBO ZEBROVANYM POVRCHEM TRUBEK PRO TEZKOVODNI REAKTOR CHLAZENY PLYNEM]
M. Halouzka Dec. 1967 47 p refs In CZECH
(UJV-1839)

A method of thermal calculations of a fuel element consisting of concentric tubes with smooth or longitudinally finned surfaces is described; fins have rectangle form. The aim of the calculation is to determine geometrical parameters of the element, assuming the permissible cladding temperature is attained at all tube surfaces and the outlet temperatures from all annular channels are equal. For the determined geometry of the element certain heat and physical values are calculated and maximum fuel and cladding temperature is checked. The method requires the use of computer and is suitable for fuel element optimization. The program has been compiled in Gier–Algol; the input tapes and the print of results are described.
Author (NSA)

N68-23062# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group.
CALCULATION OF RELATIVE DISPLACEMENT DAMAGE RATES IN DIFFERING REACTOR TYPES
I. R. Birss 23 Aug. 1967 18 p refs
(TRG-1561) CFSTI: HC$3.00/MF$0.65

A number of materials not necessarily destined for use in fast reactors, in which atomic displacements are the main damage mechanism under observation, are presently being irradiated in the Dounreay Fast Reactor. It is shown that if it can be accepted that the ratio of atomic displacement rate in the test reactor to displacement rate in the parent reactor is an acceptable parameter for comparison purposes, then the atomic displacement energy and the electronic cut off energy of a material are not critical parameters in the derivation of this ratio. It is also shown that, if the equivalent fission flux concept is used to describe reactor spectra, it can lead to appreciable errors in deriving the damage ratio, but that integration over the real spectrum is unnecessary below 0.1 MeV.
Author (NSA)

N68-23065# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
THE RESULTS OF OPTIMIZATION CALCULATIONS OF A FINNED TUBULAR FUEL ELEMENT FOR A GAS COOLED HEAVY WATER REACTOR [VYSLEDKY OPTIMALISACNIHO VYPOCTU ZEBROVANEHO TRUBKOVEHO PALIVOVEHO CLANKU PRO TEZKOVODNI REAKTOR CHLAZENY PLYNEM]
M. Halouzka Dec. 1967 39 p refs In CZECH
(UJV-1840)

A tubular fuel element with longitudinally finned tubes is described. Fuel element radius, fuel to volume ratio, height of fins, and overall pressure drop along the coolant channel are considered as independent variables. The method of physical calculations is described. The results are presented in graphical form. On the basis of this the number of tubes in a fuel element and the extent of influence of the independent variables, which appear to be the optimal ones, are determined. Some selected variations of element design are given.
Author (NSA)

N68-23066# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
XENON STABILITY OF THE A2 REACTOR, PART 2 [XENONOVA STABILITA REAKTORV A2, CAST 2]
J. Blazek and M. Krejci Aug. 1967 72 p refs 1967 72 p refs In CZECH
(UJV-1860)

In connection with the physical calculations of the active zone of a heavy water gas cooled natural U power reactor, the stability of Xe oscillations is investigated. A derivation of accurate difference equations describing the Xe oscillations considering the

temperature effect is given. The equations are formulated for the azimuthal, axial, and radial modes; the coefficients are calculated on the GIER computer with the use of the 421 U program. The input data tape and print examples are given. The simulation on an analog computer enables determination of the stability region as well as the shape of particular oscillation modes. Author (NSA)

N68-23107# AEG-Kernenergieanlage, Frankfurt am Main (West Germany).

STUDIES ON CYCLONES FOR STEAM SEPARATION IN BOILING WATER REACTORS Quarterly Report, 1 Jul.–30 Sep. 1967

Vollradt, comp. 17 Oct. 1967 22 p Transl. into ENGLISH from German

(Contract EURATOM-083-66-1 TEED)

(EURAEC-1945; EUR-3763; AEG/E31/E-811; QR-7) CFSTI: HC $3.00/MF $0.65

Work on the development of a steam generator consisting of a downflow cyclone designed to meet the requirements of the 600 MW(e) direct cycle boiling-water reactors now commonly used in Europe is described. Major modifications were made to the air/water test rig as a result of the considerations of the problem of mixture distribution to cyclones in different positions in relation to the core. One of the cyclones out of two of the three concentric rows in the reactor, together with the appropriate section from the mixture plenum with the new guide plates, was simulated on the scale 1:1. The modifications were completed and a successful trial run performed. Experiments were conducted to determine the guide plate inserts which insure that all the cyclones are subjected to mixtures of the same steam quality in all operating cases. An attempt was made to improve the design of the cyclone setup. The number of cyclones which can be used was raised from 216 to 234 without the diameter of the pressure vessel of a 600 MW(e) reactor being determined by the steam separator. Author

N68-23113# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

COMPUTER CODES FOR NUCLEAR CRITICALITY SAFETY CALCULATIONS

Hugh K. Clark Nov. 1967 88 p refs

(Contract AT(07-2)-1)

(DP-1121) CFSTI: HC $3.00/MF $0.65

Several computer codes for nuclear criticality safety evaluations are described along with their input requirements. The two basic codes are a code for computing the buckling of fissile material and a two-group diffusion theory code, which uses parameters calculated by the buckling code, for computing critical sizes. The other codes generate cross sections for the buckling code, modify two-group parameters for special cases, compute k_{eff}, and compute the effect of special shapes. Numerous correlations of the codes with data obtained in exponential and critical experiments are given to permit the user to determine the margin that must be allowed to ensure subcriticality for various situations to which the codes may be applied. Author

N68-23120# Ceskolovenska Akademie Ved, Rez. Ustav Jaderenho Vyzkumu.

ACTIVATION METHOD OF DETERMINING NEUTRON FLUENCES IN NUCLEAR REACTORS. DESIGN OF NEUTRON FLUX INTEGRATORS FOR USE IN THE VVR-S REACTOR [URCENI NEUTRONOVYCH DAVEK V JADERNYCH REAKTORECH AKTIVACNI METODOU. NAVRH NEUTRONOVYCH INTERGRATORU PRO POUZITI V REAKTORU VVR-S]

S. B. Rana Oct. 1967 48 p refs In CZECH

(UJV-1905)

A theoretical analysis of the use of foil activation techniques for neutron fluence determinations is given; time dependent flux analyses are given for foil irradiation during constant neutron flux, cyclic change in neutron flux, direct proportionality between neutron flux and reactor thermal power, unknown time dependence of the neutron flux. Reactions suitable to flux integration in the various spectral ranges are discussed. Use of ^{59}Co, ^{63}Cu, and ^{58}Ni at the WWR-S is discussed. NSA

N68-23211# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.

A PROPOSAL FOR A REPETITIVELY PULSED TEST FACILITY (RPTF)

R. G. Fluharty, F. B. Simpson, G. J. Russell, and R. H. Morris Dec. 1967 119 p refs

(Contract AT(10-1)-1230)

(IN-1149)

A preliminary reactor concept, consisting of a small plutonium booster reactor producing 3 to 10 MW of average power in conjunction with a charged particle neutron source, is proposed. Pulse frequencies variable from 0 to 200 pulses per second and widths variable between 10^{-7} and 10^{-5} seconds are obtainable with corresponding peak-power pulse-heights of 3,000 MW. In the neutron-spectrometer mode of operation, the reactor amplifies short neutron driving pulses from the charged particle source. High neutron gains and corresponding high reactor pulse power are obtained by means of rotating reactivity controls. The average reactivity of the reactor is maintained well below delayed critical, but short time operation between delayed and prompt critical permits large amplification of the source pulse. Schematic diagrams of the preliminary RPTF and system details and applications are included. NSA

N68-23220# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

MODERN FAST REACTOR CROSS SECTION SYSTEMS

S. Yiftah, M. Segev, M. Lemanska, and M. Caner Nov. 1967 16 p refs

(IA-1144)

Mainly three problems must be solved in the preparation of a group cross section set for fast reactor calculations. The first step is an evaluation of the basic nuclear data, based on experimental information, systematics, nuclear model calculations, and clarification of discrepancies. The second class of problems relates to the proper definition of group cross sections as stems from an accurate multigroup theory. The third problem concerns the weighting fluxes for the group-averaging of the data. Different group tables types stem from different structures in the flux. With the above consideration in mind, three modern group cross section sets were compared. These are the Russian 26-group set ABN, the Argonne 22-group set ANL, and the recently constructed Israeli 30-group set YSL. In the comparison, attention was paid to group structure, type of cross sections, and the representation and magnitude of self-shielding factors and temperature-dependence. Some typical fast reactor problems were run with the ABN and YSL sets; the results were compared. Author (NSA)

N68-23241# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

PRESSURIZED WATER REACTOR pH-REACTIVITY EFFECT Quarterly Progress Report, Period Ending 31 Dec. 1967

Jan. 1968 27 p refs

(Contract AT(30-1)-3696)

(WCAP-3696-6; EURAEC-1952) CFSTI: HC $3.00/MF $0.65

Progress on the experimental program to develop an understanding of the pH-reactivity effect observed in the operation of closed-cycle water reactors is described. An instrumented 3×3 fuel assembly and reactivity oscillator were installed in the Saxton reactor. The first series of pH-trip tests was conducted with the 3×3 assembly in a peripheral position. The test series consisted of reactor trip after reaching a steady state depletion rate, at high and low main coolant pH levels. Oscillator tests were conducted under steady-state conditions at high and low main coolant pH levels. NSA

N68-23263# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
OPERATIONS GROUP OF THE BR-2 REACTOR AND CONNECTED INSTALLATIONS Annual Progress Report, 1966
26 Oct. 1967 64 p
(EUR-3667)

Operation of the BR-2 and its associated installations was carried out under the Contract of Association signed between Euratom and the CEN. By the terms of this Contract, concluded in 1960 for a period of twenty years, the parties concerned use the installations, which are operated jointly for their own purposes; they may also make them available to any other parties they please for the latter's requirements. Implementation of the Contract is directed by a Management Committee, which met six times in 1966 to draw up the programs and ensure the technical coordination of the various uses to which the installations are put. Since 1963 the operation of the reactor has proved the real advantages which it derives from its unique characteristics and in particular its ability to satisfy the new requirements of experimental workers. In 1966 the help given by BR-2 to the large-scale nuclear projects of the European Community was again stepped up, while at the same time irradiation programs were also carried out for non-Community countries such as Great Britain and Japan. Author (NSA)

N68-23265# Centre d'Etude de L'Energie Nucleaire, Mol (Belgium).
USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS Quarterly Report, 1 Oct.–31 Dec. 1966
Feb. 1967 73 p refs
(Contract EURATOM-001-64-1-TRUB)
(EURAEC-1885; EUR-3381; QR-12) CFSTI: HC $3.00/MF $0.65

During the production of 112 rods for neutron tests, work continued on the major influence of the vibration conditions. The four fuel rods designed for irradiation in the Diorit Reactor were fabricated. A fission gas leak from a weld on one of the six specimens was observed. Faults appeared in the irradiation devices in the boiling water capsule tests. The examination of the BR-3/PWR fuel rods continued. Puncture, and collection of the fission gas revealed that the latter's interaction in the rods fabricated by the vibration method with plutonium in the fine grade alone is far superior to that observed on the uranium rods consisting of pellets. A very high release of CO and CO_2 was noted in the rods prepared from Dynapak powders. The Panther code was calibrated for calculation of the UO_2 and PuO_2–UO_2 lattices, adding a subroutine for burnup, adapting the Pendule one-dimensional burnup code, preparing a version of the Panther code processing by the initial collision theory to allow for heterogeneous PuO_2 distribution in the UO_2–PuO_2 rods. The adaptations being made to the VENUS critical facility were completed, apart from the positioning of the grids. NSA

N68-23288# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
HEAT EXCHANGE IN REACTOR FUEL [ROZLOZENI ZDROJU TEPLA V PALIVOVEM CLANKU]
J. Jakab Sep. 1967 25 p refs In CZECHOSLOVAKIAN; ENGLISH summary
(UJV-1876)

The determination of the space distribution of heat sources in the fuel element of a reactor after a consideration of a flattening due to γ-ray absorption and fast neutron fission is discussed. The method may be used for small burn-up fuel elements. Numerical examples are given. Author (NSA)

N68-23300# Gulf General Atomic, San Diego, Calif.
HIGH TEMPERATURE ADSORPTION STUDIES FOR THE PSC REACTOR DEVELOPMENT PROGRAM
D. R. Lofing and R. D. Burnette 30 Nov. 1967 18 p refs
(Contract AT(04-3)-633)
(GA-8083) CFSTI: HC $3.00/MF $0.65

Experimental work related to the high-temperature filter-adsorber unit for the Fort St. Vrain Power Reactor is described. Specific tests included measurements of dust or aerosol penetration as well as dynamic iodine adsorption under simulated reactor conditions of pressure, temperatue, and gas velocity. Author (NSA)

N68-23364# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FAST FLUX TEST FACILITY DEVELOPMENT MONTHLY PROGRESS REPORT, DECEMBER 1967
F. W. Woodfield 10 Jan. 1968 47 p refs
(Contract AT(45-1)-1830)
(BNWL-666) CFSTI: HC $3.00/MF $0.65

Remote weld techniques are being evaluated as an approach for the closed loop nozzle closures and piping disconnects. Mechanical seals will continue to be investigated. A new concept which provides for latching the driver closure internally in the nozzle will possibly make a significant reduction in reactor top face hardware space requirements. No significant dose rate effects on chromel-alumel thermocouples, other than gamma heating, were observed in pulsed-reactor experiments. Tests were run at a temperature of 446°F and in fluxes up to 10^{16} nv fast (>10 keV), 10^{16} nv thermal (<10 keV), and 10^{10} R/hr. Studies of the closed loop insulation requirements, methods, and materials have continued. A twin wall tube with argon in the gas gap and polished radiating surfaces appears to be one of the better thermal barrier systems. The out-of-reactor serpentine dehydration tests have been completed. Heating of serpentine for 2500 hours at 940°F resulted in a 10.8% weight loss. The original water content was 13.0%. Heating at 896 and 860°F for 2500 hours results in losses of 8.4 and 3.9% respectively. Author (NSA)

N68-23368# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FAST FLUX TEST FACILITY CRITERIA FOR CONTAINMENT
N. G. Wittenbrock Dec. 1967 27 p refs
(Contract AT(45-1)-1830)
(BNWL-607) CFSTI: HC $3.00/MF $0.65

The sources of radionuclides in the FFTF are considered; considerations for containment criteria are discussed for each facility. Operation of the containment systems is described. Design safety criteria for containment are delineated. An estimate of fission product decay heat is made from PRTR data. Possibility of FFTF fuel storage basin criticality accidents is evaluated. NSA

N68-23372# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM Quarterly Report, Aug.–Oct. 1967
G. R. Pflasterer, comp. Nov. 1967 29 p refs
(Contract AT(04-3)-540)
(GEAP-5561; QR-14) CFSTI: HC $3.00/MF $0.65

Results of SEFOR ion chamber and amplifier testing in Super-Kukla are shown; these transient tests are compared with static tests. Transient test conditions are given for SEFOR and Super-Kukla. Acceptance tests and results of the data acquisition system are detailed. Use of a reactivity computer for SEFOR is evaluated. Administrative information on fuel handling, fuel fabrication, plant construction, and training is given. NSA

N68-23470*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
REACTOR POWER SYSTEMS FOR MANNED EARTH ORBITAL APPLICATIONS

R. L. Gervais and V. D. Kirkland 1967 37 p Presented at 2nd Intersociety Energy-Conversion Eng. Conf., Miami, Fla. 13–17 Aug. 1967
(Contract NAS1-5547)
(NASA-CR-94549; Douglas Paper-4316) CFSTI: HC $3.00/MF $0.65 CSCL 18L

This paper presents design requirements resulting from integration of reactor power systems (10 to 30 kWe) with a manned Earth orbital spaced station designed for a five year mission duration; included are pertinent conclusions on design of the basic reactor power systems and their effect on the overall mission and space vehicle. The power conversion concepts investigated include the SNAP-8 type reactor in combination with the SNAP-8 and SNAP-2 mercury Rankin systems, Brayton cycle, and direct radiating and compact converter thermoelectric systems. Requirement projections resulting from this study indicate that a 20-kWe power level best satisfies the power demand of a second generation ORL application. Based on integration of the reactor power system with the MORL, modification or redefinition of mission parameters and systems are identified. Significant conclusions include: (1) reactor power systems are potentially compatible with manned missions, (2) compatibility is independent of the specific power conversion concept with the integration weight being approximately 10,000 lb for all concepts, and (3) replacement of the reactor power system is required and feasible although it has a major effect on reactor design. Author

N68-23481*# United Aircraft Corp., East Hartford, Conn.
OPTICAL ABSORPTION IN TRANSPARENT MATERIALS FOLLOWING HIGH-TEMPERATURE REACTOR IRRADIATION
F. C. Douglas, R. Gagosz, and M. A. DeCrescente Washington NASA May 1968 90 p refs
(Contract NASw-847)
(NASA-CR-1032; F-910485-2) CFSTI: HC $3.00/MF $0.65 CSCL 18M

An experimental investigation was conducted to determine the optical absorption levels induced in fused silica as a result of exposure to nuclear reactor irradiation over a range of fast neutron fluxes, fast neutron doses, and reactor temperatures. Also included in the investigation were a limited number of specimens made from alumina, hot-pressed beryllia, and single crystal beryllia. Measurements of the ultraviolet transmittance spectrum were made prior to the reactor irradiation, after the reactor irradiation, and after a series of cobalt-60 gamma irradiations. Measurements were also made during and after heat treatments at elevated temperatures. The induced absorption coefficients were determined from these measurements at the centers of absorption bands located at 0.215 and 0.163 microns. Author

N68-23559# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
NEUTRON THERMALIZATION IN A GRAPHITE-WATER SYSTEM AT LARGE TEMPERATURE GRADIENTS
L. V. Maiorov, V. I. Mostovoi, Yu. A. Safin, and G. Ya. Trukhanov Apr. 1967 18 p refs Transl. into ENGLISH from Pulsed Neutron Res. (Vienna), v. 1, 1965 p 657–668 Submitted for publication
(AERE-TRANS-1085; SM-62/109) HMSO: 2s 6d

Measurements were made of the space-energy distribution of thermal neutrons in a graphite-water system at graphite temperatures of 443°–823°K and a water temperature of 303°K. The WWR-2 reactor was used as the external neutron source. Neutron beams were extracted from different points in the graphite and the water in the direction of the neutron flux from the reactor incident on the graphite prism. The neutron spectra in the extracted beams were measured by the time-of-flight method by means of a mechanical chopper with a resolution of 20 μs/m. The measured spectra were compared with the spectra calculated using differential cross-sections for an ideal gas and the differential cross-sections obtained taking into account the chemical binding. Using the method described, the neutron rethermalization cross-section in the graphite and the water as a function of graphite temperature was calculated. Author

N68-23663# Ente Nazionale per l'Energia Elettrica (ENEL), Rome (Italy).
PROGRAM FOR USE OF PLUTONIUM IN THERMAL REACTORS [PROGRAMMA PER L'UTILIZZAZIONE DEL PLUTONIO NEI REATTORI TERMICI]
Brussels EURATOM Mar. 1968 52 p In ITALIAN; ENGLISH summary
(Contract EURATOM-092-66-6 TEEI)
(EUR-3890.I) CFSTI: HC $3.00/MF $0.65

The uranium fuel cycles for the two power plants were calculated, establishing the frequency and magnitude of reloads and the movements of fuel, and then the equivalent plutonium cycles were calculated. Taking the reference case for both plants to be the fuel cost calculated with an annual interest rate of 7.5% and a manufacturing price supplement of $20/kg, the industrial value of the fissionable plutonium was worked out. The preliminary calculations to evaluate the number of prototype plutonium elements needed to reach a critical minimum showed that the eight elements now being fabricated are amply sufficient for these experiments. The nuclear characteristics of these elements were studied. The elements will have three different fissionable Pu enrichments: 2.85%, 1.40% and 0.74%. A study was conducted to compare the dynamic behavior of the plants with cores loaded with uranium and plutonium respectively. Author

N68-23672# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
SWELLING MEASUREMENTS OF IRRADIATED FUEL SPHERES BY MICRORADIOGRAPHY
R. H. Keep Nov. 1967 11 p refs
(AERE-M-1977) HMSO: 4s

A microradiographic technique has been developed for measuring the change in volume of small fuel samples due to irradiation to high burn-ups. The fuel samples are in the form of accurately ground 500μ spheres which may have a restraining coat of pyrocarbon or pyrocarbon and silicon carbide. Specimens giving radiation doses up to 600 mr/hr/$\beta\gamma$ at 1-ft have been successfully radiographed. Dimensions were obtained to an accuracy of better than 1-1/2% using a semi-automatic scanning device. Information was also obtained on irradiation induced defects in the coatings. Author

N68-23688# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
FAST BREEDER REACTOR STATIC PHYSICS METHODS DEVELOPMENT AND ANALYSIS PROJECT Quarterly Technical Report, Oct.–Dec. 1967
D. H. Roy, J. Helholtz, and A. Z. Livolsi Feb. 1968 27 p refs
(Contract AT(30-1)-3867)
(BAW-3867-2) CFSTI: HC $3.00/MF $0.65

The development and utilization of a design-oriented, one-dimensional criticality and depletion code applicable to the physics analysis of fast reactors are discussed. The code development program includes: execution of MC^2 by using an ETOE generated library; the programming initiated for RETAP routine; the adaption of free-format input subroutines for use by FARED; and the specifications of FARED control, edit, and depletion routines. NSA

N68-23759 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE NEUTRON DIFFUSION PARAMETER MEASUREMENTS IN GRAPHITE OF THE ANNA REACTOR [POMIAR PARAMETROW DYFUZJI NEUTRONOW W GRAFICIE REAKTORA ANNA]

S. Chwaszczewski, A. T. Mikulski, and K. Dybowski 1967 23 p refs Transl. into ENGLISH from Polish
(IBJ-853/IXA/PR) CFSTI: $3.00

This work is devoted to the measurement of parameters in the graphite of the ANNA reactor. It is done by the pulsed neutron source method and based on the determination of the decay constant for few space dependent distributions of higher harmonics. The results are in agreement with other measurements. It makes possible to confirm that the graphite in the ANNA reactor is in agreement with generally accepted standards of nuclear grade graphite. Author

N68-23787# Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena.
CAVITATION PHENOMENA IN LIQUID METALS
F. G. Hammitt Dec. 1967 13 p refs
(NP-17279)

Aspects of cavitation in liquid metals are reviewed, including the various applications. Cavitation and related phenomena are of importance in sodium-cooled fast neutron breeder reactors, and the problems involved are discussed. Detailed theoretical considerations wherein reactor temperature sodium might be expected to differ from ambient temperature water are reviewed, and the relatively scattered applicable engineering results from component tests which have been published are considered. Author (NSA)

N68-23871# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PCTR MEASUREMENT OF K ∞ FOR URANIUM LITHIUM SUPERCELL
D. F. Newman 20 Dec. 1967 70 p refs
(Contract AT(45-1)-1830)
(BNWL-622) CFSTI: HC $3.00/MF $0.65

Experimental values for infinite medium neutron multiplication factor, k_∞, have been determined for a graphite moderated supercell utilizing 2.1% enriched U fuel and 2.93 wt % Li-in-Al target in separate process tubes, in a three-to-one ratio. Determinations of k_∞ were made with the coolant channels wet and dry to obtain an estimate of the reactivity coefficients due to water loss. Both a 6×6 and 5×5 array of test cells were inserted in the PCTR test cavity for these measurement. Results of experimental measurements are listed. Author (NSA)

N68-23881# Naval Research Lab., Washington, D. C.
IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 Nov. 1967–31 Jan. 1968
J. Russell Hawthorne, Uldis Potapovs, and Charles Z. Serpan, Jr. 15 Feb. 1968 56 p refs Sponsored in part by AEC and Army
(NRL-MEMO-1853; AD-667464)

The research program of the NRL Metallurgy Division, Reactor Materials Branch, is devoted to the determination of the effects of nuclear radiation upon the properties of structural materials. The overall program is sponsored by the Office of Naval Research, the Naval Ship Systems Command, the U. S. Atomic Energy Commission, and the Army Nuclear Power Program. Since research findings which apply to the objectives of one sponsoring agency are also of interest to the others, the overall program progress is reported herein. This report, covering research for the period 1 November 1967 - 31 January 1968, includes the following: (1) an evaluation of copper, vanadium, and nitrogen content as variables in radiation embrittlement sensitivity of A302-B steel, (2) the thermal aging response of A302-B plates from a laboratory split heat modified with sulfur and phosphorus additions, (3) an evaluation of the effect of aluminum and nitrogen additions on radiation embrittlement sensitivity of Ni-Cr-Mo steel, (4) the notch ductility characteristics of experimental Cr-Ni-Mo precipitation hardening stainless steel after <250F irradiation, and (5) an assessment of embrittlement relief accomplished through in-place annealing the SM-1A reactor pressure vessel. Author (TAB)

N68-23892# Societa Nazionale Metanodotti, Milan (Italy). Laboratori Riuniti Studi e Ricerche.
DEVELOPMENT OF A METHOD FOR CALCULATING PLUTONIUM-ENRICHED CORES FOR THE PURPOSE OF PLUTONIUM RECYCLING IN THERMAL REACTORS [MESSA A PUNTO DI UN METODO PER IL CALOLO DI NOCCIOLI ARRICCHITI IN PLUTONIO AI FINI] Final Report
R. Corona, G. Ghilardotti, G. Imperato, B. Montagnini, F. Pasquinelli et al Brussels EURATOM Mar. 1968 268 p refs
(Contract EURATOM-072-65-11 TEEI)
(EUR-3891.I) CFSTI: HC $3.00/MF $0.65

The development of suitable methods of calculating the group constants of light-water moderated lattices, with plutonium-containing fuel is discussed. Calculation of the group constants is needed in three different problems: (1) Reference calculations. Here the calculating method, no matter how complex and laborious, must produce the best obtainable data for the theoretical determination of criticality and flux distributions. (2) Parameter surveys. The calculating time for an individual item is limited by the breadth of the field to be investigated. (3) Lifetime calculations, fuel cycle. The time limits in this case are even more exacting. Author

N68-23894*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
REACTIVITY INSERTIONS IN COMPACT REACTOR CORES DUE TO FUEL MOVEMENT
Robert E. Sullivan Washington May 1968 14 p refs
(NASA-TM-X-1587) CFSTI: HC $3.00/MF $0.65 CSCL 18J

The reactivity effect of fuel movement in several compact reactor cores, highly fueled with uranium-233 dioxide was calculated using a computer program to solve the Boltzmann transport equation. Author

N68-23960# Atomic Energy Commission Research Establishment, Riso (Denmark).
LEAKAGE MEASUREMENTS OF THE DR 3 CONTAINMENT DURING REACTOR OPERATION TO MEET A DEMAND OF MAXIMUM 0.1 % LEAKAGE PER 48 HOURS
Karsten Haack Dec. 1966 17 p refs
(RISO-137) CFSTI: HC $3.00/MF $0.65

The ratio between the absolute temperature T and the partial pressure P of the atmospheric air in the hall is taken as a representative of the number of air moles present. A plot versus time gives the leak rate. The temperature is measured by means of an iron wire through the hall; the pressure is determined by projecting the mercury surface of a precision manometer onto a screen. The arrangements and the measurement equipment are described and the uncertainties of the results discussed. The experiences from six yearly tests have led to a method which is considered to be more convenient than that used previously, and yet sufficiently accurate to control the tightness of the DR 3 reactor building. Author (ESRO)

N68-24337# Atomics International, Canoga Park, Calif.
A DESIGN STUDY FOR FAST FLUX TEST FACILITY SECONDARY GAMMA SHIELD
J. V. Facha and J. G. Roberts 20 Dec. 1967 107 p refs
(Contract AT(04-3)-701)
(NAA-SR-MEMO-12586) CFSTI: HC $3.00/MF $0.65

Fuel handling and radioactive maintenance modes which involve occupancy of the reactor hot cell by the operating personnel utilize a secondary gamma shield over the reactor. The requirements are defined and the feasibility of such a shield is established for the FFTF reactor. Alternate rotating and stationary design concepts are presented and evaluated. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-23145# Cornell Univ., Ithaca, N. Y.
A MODEL CALCULATION OF THE LIQUID STRUCTURE FACTOR OF LIQUID HELIUM-4
William Clayton Kerr (Ph.D. Thesis) Sep. 1967 127 p refs
(Contract AT(30-1)-3699)
(NYO-3699-20) CFSTI: HC $3.00/MF $0.65

A method is devised for calculating liquid structure factors of liquid ^{4}He using interpolation techniques on the theory of gases and solids. NSA

N68-23170# TRW Systems, Redondo Beach, Calif.
RESEARCH ON ELECTROSTATIC CHARGED DROPLET STREAMS Final Report, Jul. 1963–Aug. 1966
Ralph F. Wuerker Wright-Patterson AFB, Ohio ARL Oct. 1967 174 p refs
(Contract AF 33(615)-1035)
(TRW-99900-6299-R000; ARL-67-0211; AD-666669)

The research was concerned with the experimental and theoretical study of the charged particle emission from metal capillaries at high electrical voltage (10 kilovolts) and containing conducting oils under pressure. Experimental techniques employed and developed under the program included shadowgraph with the repetitively pulsed Xenon arc, conventional microscopy with Xenon arc illuminators, dark field imagery with Xenon arc, stero-shadowgraph with the Xenon arc, shadowgraph with the pulsed ruby laser, and holographic microscopy with pulsed ruby and continuous wave helium-neon laser illuminators. The experimental observations demonstrated that the conducting glycerin was pulled by the applied electric field into microscopic filaments which then underwent the classical electrohydrodynamic instabilities. A byproduct of the investigations on holographic microscopy was the discovery of pulsed laser holographic interferometry. Author (TAB)

N68-23323# Houston Univ., Tex. Dept. of Mechanical Engineering.
FINITE DIFFERENCE SOLUTIONS OF THE ACOUSTIC RADIATION EQUATION IN THE NEAR FIELD
Yeh-Pei Lu and S. Bart Childs Sep. 1967 55 p refs
(Contract Nonr-4492(01))
(TR-7; AD-666960)

Numerical methods for the solution of the finite difference approximation to the acoustic radiation equation are discussed. For a spherical radiator, the Gauss-Seidel iterative method and the alternating direction implicit method are employed to solve the discrete approximation of the Helmholtz equation in the near field. Emphasis is on the development of the general numerical method and on the extrapolation scheme used to increase the rate of convergence. Measures of the number of calculations needed for various methods of solution are reported. A discussion of the nature of the acoustic radiation problem in numerical computation is also presented. Author (TAB)

N68-23517 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
ION FOCUSING PROPERTIES OF A DOUBLE MAGNETIC QUADRUPOLE LENS PAIR
L. Freindl and W. Karcz Dec. 1967 20 p refs
(INP-579/PL) CFSTI: $3.00

In the present work a double magnetic quadrupole lens pair set used to focus nuclear particles from nuclear reactions is described. Experimental parameters of the lens are compared with theoretical ones. Application of a quadrupole lens pair set in polarization measurements is discussed. Author

N68-23550 New York Univ., N. Y.
DIFFRACTION BY AN ANISOTROPIC DISK, PERFECTLY CONDUCTING ALONG EQUIANGULAR SPIRALS
Lester Alan Rubenfeld (Ph.D. Thesis) 1966 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-629

The problem of the diffraction of electromagnetic waves by a small circular disk which is perfectly conducting along equiangular spirals is studied. The limiting cases where the spirals degenerate into circles and radial segments are also discussed. General modal excitation appropriate to the cylindrical geometry of the problem is assumed. The solution is given in the form of integral representations. These representations, which involve a pair of unknown functions, are designed so as to automatically satisfy Maxwell's equations, the continuity conditions outside the disk, the edge conditions and the radiation condition. The remaining conditions, specifically, that the current is directed along the spirals and that the total electric field in the direction of the spirals vanishes, leads to a pair of coupled integro-differential equations for the unknown functions. Dissert. Abstr.

N68-23765 Arizona Univ., Tucson. Optical Sciences.
PRECISION OPTICAL TECHNOLOGY Final Report
Mar. 1968 18 p refs
(Contract Nonr-2173(12))
(AD-667606)

Many of the technical projects undertaken at the Optical Sciences Center eventually form the basis for formal publications in various professional journals; however, the time lag associated with such journal publication has become so long that an interim communication mechanism, such as a technical report, is a practical necessity. Therefore, it is the basic policy of the Optical Sciences Center to issue technical reports whenever specific programs or tasks reach appropriate milestones. Author (TAB)

N68-23786 Electro-Mechanics Co., Austin, Tex.
EM SHIELDING OF BUILDING MATERIALS Final Report, May 1966–Jun. 1967
C. M. Brennan, C. C. Lambert, C. G. Conner, G. F. Roberts, W. T. Flannery et al Griffiss AFB, N. Y. RADC Feb. 1968 183 p
(Contract AF 30(602)-4275)
(RADC-TR-67-446; AD-667546)

This report covers the results of a program for measuring the shielding effectiveness (SE) of building materials. Part 1 of the report describes a number of techniques which were used to make radiated measurements of magnetic field SE from 10 Hz to 50 KHz and conductive measurements from 10 Hz to 1 GHz. A method was introduced for plotting the low frequency field distribution about various shaped ferromagnetic enclosures. Part 11 contains a group of the significant results of the radiated measurements on a variety of building materials. A collection of tables shows the measured electrical parameters and the calculated shielding obtainable from a cross-section of dielectric building materials. Author (TAB)

N68-23855# Georgetown Univ., Washington, D. C. Dept. of Physics.
PRODUCTION AND MEASUREMENT OF ULTRASONIC SURFACE WAVES
David C. Auth and Walter G. Mayer Mar. 1968 37 p refs
(Contract Nonr-5037(01))
(TR-3; AD-667591)

Techniques for exciting ultrasonic surface waves and their advantages are described. Preferred methods for particular applications are given. Experimental correlation is made to theory for light scattering from surfaces excited with Rayleigh waves. Data are given for velocity and wave amplitude measurements obtained by light scattering. Use of light scattering is considered for investigating surface states, Rayleigh wave dispersion and absorption. Author (TAB)

N68-23956# Toronto Univ. (Ontario). Dept. of Physics.
NORMAL AND STIMULATED RAMAN SPECTROSCOPY Semiannual Report
Boris P. Stoicheff Dec. 1967 22 p refs
(Contract Nonr-5012(00); ARPA Order 306)
(SAR-5; AD-666820)

CONTENTS:
1. RAMAN LINEWIDTHS FOR STIMULATED THRESHOLD AND GAIN CALCULATIONS W. R. L. Clements and B. P. Stoicheff 12 p refs (See N68-23957 13-23)
2. ANGULAR DISTRIBUTION OF "SURFACE" RADIATION IN STIMULATED RAMAN SCATTERING FROM LIQUID MIXTURES F. Shimizu, U. Bachmann, and B. P. Stoicheff 10 p refs (See N68-23958 13-23)

N68-23957# Toronto Univ. (Ontario). Dept. of Physics.
RAMAN LINEWIDTHS FOR STIMULATED THRESHOLD AND GAIN CALCULATIONS
Walter R. L. Clements and Boris P. Stoicheff *In its* Normal and Stimulated Raman Spectry. Dec. 1967 12 p refs Sponsored in part by Natl. Res. Council, Canada (See N68-23956 13-23)
(Proj. Defender)

Linewidths in the normal Raman spectra of several liquids of interest in stimulated Raman scattering have been measured including carbon disulfide, benzene, toluene, oxygen and nitrogen. The spectra were excited with 6328 Å radiation from a He–Ne laser and examined with a pressure-scanned Fabry–Perot interferometer. Author

N68-23958# Toronto Univ. (Ontario). Dept. of Physics.
ANGULAR DISTRIBUTION OF SURFACE RADIATION IN STIMULATED RAMAN SCATTERING FROM LIQUID MIXTURES
Fujio Shimizu, Urs Bachmann, and Boris P. Stoicheff *In its* Normal and Stimulated Raman Spectry. Dec. 1967 10 p refs Sponsored in part by Natl. Res. Council, Canada (See N68-23956 13-23)
(Proj. Defender)

Anti-Stokes emission in sharply defined cones has been observed in acetone (at $\Delta\nu$ = 2920 cm^{-1}) mixed with 5 to 10% cs_2. The cone angle is in agreement with the momentum-matching condition so that the longitudinal but not the transverse components sum to zero. Author

N68-23986*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATTENUATION OF SOUND IN SOFT WALLED CIRCULAR DUCTS
Edward J. Rice Washington 1968 24 p refs Presented at Symp. on Aerodym. Noise, Toronto, Can., 20–21 May 1968
(NASA-TM-X-52442) CFSTI: HC $3.00/MF $0.65 CSCL 20A

A theory is presented which appears capable of predicting the attenuation of broad-band sound in soft walled circular ducts. The axially symmetric separable solutions to the linear wave equation in cylindrical coordinates were obtained. It was assumed that the steady velocities and pressure fluctuations were small. The first ten characteristic function solutions were fit to form a traveling plane pressure wave at the lined duct entrance by means of a Fourier–Bessel series expansion. The eigenvalues are complex numbers due to the finite wall impedance boundary condition. The present theory shows a strong dependence of sound attenuation on frequency. This dependence occurs through the ratio of the duct diameter to sound wavelength. The theory was used to calculate the noise reduction obtained with a perforated plate liner on a J-65 engine inlet. The liner design was based upon an approximate theory valid for very hard walls. The present theory showed excellent agreement with experimental measurements. Author

N68-24007 Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON NONLINEAR ACOUSTICS Final Report, 15 Nov. 1964–15 Sep. 1966
Clarence M. Ablow, Leonard D. McCulley, George M. Muller, Anthony J. Penico and Yapa D. Rajapakse Wright-Patterson AFB, Ohio AMRL Dec. 1967 189 p refs
(Contract AF 33(615)-2234)
(AMRL-TR-67-54; AD-667223)

The possibility that nonlinear acoustic flows may be represented by spherical progressive waves (in the sense of Courant and Friedrichs) was examined and found to be unlikely. An iterative finite-difference method for the calculation of continuous periodic spherical flows was developed together with a FORTRAN code, SPHERE, that implements the method. Sample calculations have shown that the code is effective but slow, and several ways for reducing the computation time are suggested. Convergence difficulties in one of the iterative loops were overcome by the use of a semi-iterative underrelaxation scheme. When applied to linear systems, such semi-iterative schemes were found to be equivalent to a class of summability methods that may be regarded as generalizations of Euler summation. Author (TAB)

N68-24148*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THEORETICAL APPROACH TO THE DETERMINATION OF MAGNETIC TORQUES BY NEAR FIELD MEASUREMENT
J. C. Boyle, J. Greyerbiehl, and E. J. Mosher Washington May 1968 22 p refs
(NASA-TN-D-4485) CFSTI: HC $3.00/MF $0.65 CSCL 20C

Using the concept of stress in the medium as postulated by Faraday and developed mathematically by Maxwell and Jeans, equations are derived for the torque on a magnetic object immersed in an arbitrary magnetic field. The calculation requires a knowledge of the magnetic intensity vector over any closed surface which encompasses the magnetic object of interest. Torque equations are derived for the case where the closed surface is a sphere of arbitrary radius and also where the closed surface is a right circular cylinder. The validity of the equations is tested by applying them to a simple intensity distribution (that of a theoretical dipole) where the resultant torque is known a priori. There is also a discussion of permanent versus induced moments and a technique which can be used to separately identify these components based on near field information. Author

N68-24184# Queens Coll., Flushing, N. Y. Dept. of Physics.
A NOTE ON THE LORENTZ TRANSFORMATION
A. L. Harvey Mar. 1968 11 p
(Contract N00014-68-C-0293)
(TR-1; AD-667480)

The purpose of the note is to present a simple derivation of the most general form of the homogeneous Lorents transformation. In the process, the decomposition of a generic element, L = P lambda R where P and R are pure spatial rotations and lambda is the one-dimensional pure Lorents transformation, is obtained. TAB

N68-24194# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NUMBER 5 Monthly Review of Selected Foreign Scientific and Technical Literature
May 1968 61 p refs

Discussed are transmission channel amplitude and phase equalizers that utilize a two-terminal pair network with an inverse transfer function to compensate for the signal degradation by amplitude and phase distortions in a non-ideal transmission channel. Also discussed is the treatment of infectious virus diseases and miscellaneous diseases of the eye, lungs, and intestines by nuclei and proteolytic enzymes. Results showed that enzyme therapy alleviated symptoms of contagious diseases. A survey on basic results obtained in the department of mathematical physics for the theory of nonlinear oscillations is included. Appendices cover various studies in the areas of synthesis and chemical properties of polymers, structure of polymers, polymer solutions, and general laws governing the polymer state. A brief note describes symposiums on seismology and polymer structure. G.G.

N68-24212# United Research Services, Burlingame, Calif.
SOLITARY WAVES ON A 45-DEG SLOPE Final Report
N. R. Wallace and R. Wonderly Jun. 1967 76 p refs
(Contract N00014-66-C-0342)
(URS-670-2; AD-667839)

The report completes a study of solitary waves shoaling on a 45-deg slope. Computed wave shapes in various stages of deformation are presented and a direct comparison with experimental wave shapes is made. Agreement is uniformly good over the whole range of stages of deformed wave motion and for all wave heights from the inception of runup to the final stages of fluid motion on the slope. A study was also made of improving the accuracy of the steady-state representation of a solitary wave through use of a two-dipole approximation to the potential greater accuracy was obtained with little change in the wave shape from the single-dipole representation used heretofore. Author (TAB)

N68-24257 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF ATMOSPHERIC OPTICAL PROPERTIES [OB USTOYCHIVOSTI OPTICHESKIKH SVOYSTV ATMOSFERY]
G. Sh. Livshits 18 Aug. 1967 12 p refs Transl. into ENGLISH from Vestn. Akad. Nauk Kaz. SSR (Alma-Ata), no. 1, 1965 p 21–26
(FTD-MT-24-167-67; AD-667701)

The extent of the changes in atmospheric transparency were studied analytically to determine its effect on the optical stability of the atmosphere, given by a stability criterion. A progressive method of measuring the optical properties of the atmosphere is proposed, and a coefficient n is defined as the degree of atmospheric instability. A set of 80 observations was selected over a period of 50 days, 60 of which showed n not exceeding 0.03. It was found that n could vary in a given day (during the observation series) with different filters. This was attributed to the change in aerosol quantity in the atmosphere as well as the aerosol spectra. All data were limited to clear atmospheric conditions with high transparency. TAB

N68-24274# RAND Corp., Santa Monica, Calif.
BACKSCATTER LIMITATIONS IN ACTIVE NIGHT-VISION SYSTEMS
H. Steingold and R. E. Strauch Feb. 1968 59 p refs
(Contract F44620-67-C-0045)
(RM-5442-PR; AD-667206)

This study explores atmospheric backscatter as a fundamental limitation in using an artificial light source for night viewing. A mathematical model of an active night-vision system is constructed, and formulas are derived for the signal received from a target and the backscatter caused by the intervening atmosphere. Signal-to-noise ratio is defined, and its use as a measure of system performance is discussed. Several hypothetical systems are evaluated, and graphs of the signal-to-noise ratio as a function of range are presented. Additional graphs show the power that would be required by the systems to achieve a given signal-to-noise ratio as a function of range. Author (TAB)

N68-24276# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
ULTRASONICS AND HYPERSONICS. A REVIEW
W. P. Mason Feb. 1968 50 p refs
(Contract Nonr-266(91))
(TR-55; AD-667735)

Ultrasonics has been defined as the science of sound waves above the audible (i.e. above 20 KHZ). Such waves have a variety of analytical uses and engineering applications. Low amplitude applications are sonar systems, delay lines, mechanical filters, ultrasonic inspectoscopes, thickness gages and ultrasonic imaging. High amplitude ultrasonics have been used in cleaning (by cavitation) machining and welding, aglomeration of particles and medical therapy. Analytical uses are in investigating relaxation in gases, liquids and solids, domain wall motions in magnetic materials and in low temperature effects in liquid helium and in superconductors. Hypersonics is the extension of ultrasonics to frequencies from 500 MHZ to the limiting frequencies transmitted by liquids and solids. The methods used are acoustic pulse transmission, Brillouin scattering and thermal pulse methods. The last method has shown that in insulators thermal motions arrive as sound pulses a finite time after initiation. In metals the arrival time is determined by the Fermi velocity of the electrons.
Author (TAB)

N68-24290# California Inst. of Tech., Pasadena. Engineering and Applied Science Div.
A PHYSICAL MODEL OF LIQUID HELIUM
Din-Yu Hsieh Mar. 1968 18 p refs
(Contract N00014-67-0094-0009)
(Rept.-85-43; AD-667601)

A new physical model of liquid He4 based on the hypothesis that rotons behave like tiny quantized circular vortex rings is presented. It is shown that the energy of a state will not only depend on the distribution in numbers of rotons with various momenta, but also on the arrangements and orientations of the rotons. The lambda-transition then can be interpreted to reveal two aspects: T sub lambda is both the lowest temperature at which all helium atoms partake in excitation, and the point of the initiation of the general destruction of order, i.e. the general randomization of the orientation of the rotons. Other implications from the theory are also discussed. Author (TAB)

N68-24328 California Inst. of Tech., Pasadena. Engineering and Applied Science Div.
ULTRASONIC CAVITATION IN LIQUID HELIUM
Din-Yu Hsieh Mar. 1968 20 p refs
(Contract N00014-67-0094-0009)
(Rept.-85-44; AD-667602)

Based on the new interpretation that rotons behave like tiny quantized vortex rings, a theory is constructed to give a complete picture of ultrasonic cavitation in liquid helium. The problem of nuclei of cavitation is approached from a new direction. Questions like the lambda-peak of the audible threshold, the distinction among audible, incipient visible and desinent visible cavitation thresholds in He II, the lack of such distinction in He I, the reduction of audible threshold by rotation in He II and the absence of such reduction in He I, are satisfactorily explained. The relevance of the present theory to cavitation in ordinary liquids is briefly discussed. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-23048# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
NUCLEAR OCTUPOLE DEFORMATIONS
P. Vogel 1967 22 p refs Submitted for publication
(JINR-E4-3629)

The dependence of the nuclear potential energy on the parameters of the quadrupole and octupole deformation for nuclei in the $218 \leq A \leq 232$ region is investigated. The energy is calculated in the framework of the superfluid nuclear model. The minimum of the potential energy surface is obtained for $\beta_3=0$, i.e., there are no nuclei with nonzero equilibrium octupole deformation in the region considered. The dependence of the energy on the deformation differs essentially from the simple parabolic one; particularly a term of the type $C_{23}\cdot\beta_2\cdot\beta_3$ is present in E (β_2, β_3) leading to an asymmetric energy surface and to an interaction between β vibrations and octupole vibrations. Author (NSA)

N68-23049# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
THE DECAY OF Ho-159 [RASPAD Ho-159]
A. A. Abdurazakov, Zh. Zhelev, V. G. Kalinnikov, J. Liptak, F. Molnar et al 1967 21 p refs In RUSSIAN Submitted for publication
(JINR-P6-3634)

The γ-ray and conversion spectra emitted at the decay of ^{159}Ho were investigated. New γ transitions with the energies 302.6, 336.0, 408.4, 460, 566.8, 588.9, 712, and 797 keV were observed. The multipolarities of the most ^{159}Ho γ transitions were determined. On the basis of the data obtained, a scheme of the ^{159}Dy excited levels is proposed. Author (NSA)

N68-23058# Atomics International, Canoga Park, Calif.
ELIMINATION OF THE EFFECT OF A CONSTANT NEUTRON SOURCE IN REACTIVITY MEASUREMENTS
R. J. Tuttle 31 May 1967 36 p refs Revised
(Contract AT(04-3)-701)
(NAA-SR-MEMO-12290, Rev.) CFSTI: HC $3.00/MF $0.65

Elimination of the perturbing effect of a constant neutron source in low-power reactivity measurements can be accomplished by inclusion of this effect in the dynamic reactivity measurement method. This method uses a computer to determine the instantaneous reactivity from the reactor power history. Use of this method is demonstrated, including determination of the source perturbation, for calibration of a regulating rod in the ECEL reactor. The source perturbation ranged from zero to about 6 cents in these calibrations; this was reduced to less than the statistical uncertainty of the measurements, about 0.1 cent, by use of this method. Additional information regarding dynamic reactivity measurements, including a description and listing of the computer program used, is presented. Author (NSA)

N68-23072 California Inst. of Tech., Pasadena.
POSITIVE PION PHOTOPRODUCTION AT ANGLES FROM 50° TO 165° C.M. AND ENERGIES FROM 500 TO 1350 MEV
Henry A. Thiessen (Ph.D. Thesis) 1967 172 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-4779

The cross section for the reaction $\gamma + p \rightarrow \pi^+ + n$ was measured at the Caltech synchrotron. The π^+ was detected in a multi-channel magnetic spectrometer, and the data were recorded in the memory of a pulse height analyzer. The results are presented in the form of energy distributions at 12 fixed laboratory angles from 34° to 155°. A total of 378 cross section measurements are reported with photon energies between 500 MeV and 1350 MeV. No detailed fitting of the entire angular range was attempted; however, a narrow bump in the cross section at 180° is explained as the effect of a cusp at the eta meson threshold. Dissert. Abstr.

N68-23073 Florida Univ., Gainesville.
VELOCITY DEPENDENT BOSON EXCHANGE POTENTIALS AND NUCLEON–NUCLEON SCATTERING IN THE BORN APPROXIMATION
Ravi Dutta Sharma (Ph.D. Thesis) 1966 295 p
Available from Univ. Microfilms: HC $13.30/MF $3.80 Order No. 67-3506

An attempt has been made to understand the nucleon–nucleon (NN) interaction in terms of the One-Boson-Exchange-Potential (OBEP) model and to account for NN elastic scattering phase-shifts in the Born approximation for non-relativistic energies (25–310 Mev) in the laboratory frame. Theoretically, the OBEP are derived by Green, the resulting expressions being given in the Diracian form. The two particle Dirac equation is reduced to a Schrodinger–Pauli form using a method similar to Breit's method of reduction to large components. A general form of interaction is then obtained in the Pauli-form which is applied to scalar, psuedoscalar and three different forms of vector meson exchange potentials. Dissert. Abstr.

N68-23075 Stanford Univ., Calif.
FAST-NEUTRON ACTIVATION CROSS SECTIONS FOR NA^{23}, MN^{55}, IN^{115}, AND HO^{165}
Howard Olsen Menlove (Ph.D. Thesis) 1966 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-4405

Activation cross sections for the $Na^{23}(n,\gamma)$ Na^{24}, $Mn^{55}(n,\gamma)Mn^{56}$, $In^{115}(n,\gamma)In^{116m}$, and $Ho^{165}(n,\gamma)Ho^{166}$ reactions have been measured by activation techniques at 17 neutron energies between approximately 1.0 and 19.5 MeV. Neutrons were produced by means of the $T(p,n)He^3$, $D(d,n)He^3$, $Be^9(\alpha,n)C^{12}$, and $T(d,n)He^4$ reactions using a 3.5-MV Van de Graaff accelerator. The measurements were made relative to the fission cross section of U^{235} for fast neutrons. A thermal-neutron irradiation in a reactor was made in order to obtain cross sections normalized to the thermal activation cross sections of the irradiated samples and the thermal fission cross section of U^{235}. The (n,2n) cross section measurements from the present experiment have been compared with semi-empirical cross section theories. The agreement of the measurements with the calculated (n,2n) cross sections is good up to the (n,3n) threshold energy where the calculated cross sections drop below the measured cross sections. Dissert. Abstr.

N68-23076 Texas A&M Univ., College Station.
ELASTIC NUCLEON–DEUTERON SCATTERING WITH TENSOR INTERACTION
Robert Daniel Purrington (Ph.D. Thesis) 1966 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-4716

The theory of low energy elastic nucleon–deuteron scattering in the presence of a tensor force has been developed using the Born approximation, with modification. The Angular distributions have been calculated for elastic neutron–deuteron scattering at energies from 0.99 MeV to 22 MeV and have been found to differ little from the central force calculations. The theory of polarization in nucleon–deuteron scattering has been given in some detail and numerical results obtained for the polarization of the scattered nucleon in the energy range 0.99 MeV to 22 MeV. The results show substantial qualitative agreement with experiment and permit some conclusions to be made about the deuteron D-state admixture. Dissert. Abstr.

N68-23077# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
QUADRUPOLE MOMENT OF THE $K^\pi=0^+$ EXCITED STATE IN ODD Lu-172
J. Jastrzebski, M. Moszynski, Z. Preibisz, K. Stryczniewicz, P. Paris et al 1967 16 p refs Submitted for publication
(INR-P-843/IA/PL)

An investigation of $^{172}Hf(T_{1/2}=5$ yr) decay was carried out after the sample was chromatographically purified of

the daughter ^{172}Lu (6.5 day) isotope. The half-lives of the 110-keV (2^+) and 192 keV (1^+) states of ^{172}Lu were measured to be 2.30±0.12 nsec and ≤0.5 nsec, respectively. The B(E2) of the 44-keV transition is calculated assuming the theoretical conversion coefficient α_T=1.31. The value obtained for B(32)↑ is 5.6 ±0.28×10^{-48}e^{2}cm^2. Assuming no band mixing the intrinsic quadrupole moment of the |p7/2+[404]; n7/2+[633]| K=0 rotational band was determined to be Q_{02}=7.50±0.20 barns. The γ-ray intensities measured with Ge(Li) detectors confirm the decay scheme. Author (NSA)

N68-23092# Paris Univ., Orsay (France). Division de Physique Theorique.
FORWARD NN AND N ANTI N CHARGE EXCHANGE SCATTERING AT HIGH ENERGY
P. Gauron and M. Lacombe Nov. 1967 10 p refs
(IPNO/Th-108)

The existence of the speculative ρ', having the same quantum numbers as the ρ, is assumed, and N+N and N+$\bar{N}$ scattering only are considered. The possibility of additional terms in the forward differential cross sections permits the ρ' parameters to be varied. Then solutions consistent either with evasion or conspiracy can be found, the latter fitting the data slightly better. But these two eventualities cannot be distinguished due to experimental uncertainties. The possibility of a ρ P cut is considered. Although crude approximations were used, it seems impossible to fit the forward differential cross sections without the help of a conspiracy, either of the cut with itself or between poles. Good results were obtained with a pole A_1 such that $\alpha_1(0) = -0.2$. But a self-conspirating cut cannot be excluded. NSA

N68-23114# Paris Univ., Orsay (France).
DERIVATION OF NONRELATIVISTIC SUM RULES FROM CAUSALITY
K. Chadan and A. Montes Oct. 1967 51 p refs
(LPTHE-TH-219)

Nonrelativistic sum rules obtained previously in the framework of elastic scattering by a local potential are shown to follow from the Causality Principle of Wigner and Van Kampen. It is shown in fact that under the mild and plausible assumption that the phase shift, in the limit of high energy, goes to a multiple of π such as to satisfy conditions (6a,b) and the Levinson theorem, the causality condition is equivalent to assuming a local potential inside the interaction region. In other words, it is shown that any interaction which is causal and for which (6a,b) and the Levinson theorem hold is equivalent to a local potential of radius R. Author (NSA)

N68-23118# Grenoble Univ. (France).
CONTRIBUTION TO STUDY OF DECAY SCHEME OF ^{183}Hf [CONTRIBUTION A L'ETUDE DU SCHEMA DE DESINTEGRATION DU ^{183}Hf]
Youssef Motevalledi Nobar (Ph.D. Thesis) [1966] 70 p refs In FRENCH
(NP-17219)

The reaction ^{186}W(n,α) ^{183}Hf was used in the study of the decay scheme of ^{183}Hf. A chromatographic separation developed in the laboratory of nuclear chemistry at Grenoble made it possible to eliminate to a great extent isotopes other than ^{183}Hf formed by (n,p), (n,α), and (n,2n) reactions. The methods used for the preparation of the sources are outlined. The γ and β spectrometric methods used for the identification and determination are described in detail. Direct γ spectrometry, γ-γ coincidence spectrometry, and β spectrometry were used. On the basis of the results obtained, a partial decay scheme of ^{183}Hf is presented. NSA

N68-23119# Grenoble Univ. (France).
STUDY OF EXCITED LEVELS OF ^{155}Gd OBTAINED FROM ^{155}Eu [ETUDE DES NIVEAUX EXCITES DU GADOLINIUM 155 OBTENUS A PARTIR DE L'EUROPIUM 155]
Claude Foin (Ph.D. Thesis) 5 Dec. 1966 45 p refs In FRENCH
(NP-17212)

The experimental techniques used for the study of the excited levels of ^{156}Gd are outlined. The experimental results are discussed at length. The internal conversion spectrum obtained with a high-resolution spectrometer made it possible to determine with precision the relative intensities of different conversion-electron rays and to deduce the multipolar order of the majority of the transitions. The measurements are in good agreement with the theoretical values of Sliv and with the measurements of Harmatz. The study of the spectra with a Ge junction made it possible to give an order of magnitude of the intensity of the 146-keV photon which was observed only by Coulomb excitation. The external conversion spectra gave with good precision the relative intensities of the different photons. From different measurements, the spin I=5/2 and its projection K=5/2 for the level at 105.3 keV were deduced. An absolute determination was made of the α_K coefficients of the 86.5- and 105.3-keV transitions. NSA

N68-23144# London Univ. (England). Dept. of Physics.
DISPERSION RELATIONS IN HIGH ENERGY PHYSICS Final Report, 1 Nov. 1964–30 Sep. 1967
Harrie Massey 31 Oct. 1967 16 p refs
(Grant AF-EOAR-64-62)
(AFOSR-68-0519; AD-666680)

A phase shift analysis of pion-nucleon scattering up to 1.5 GeV was made which revealed a quantity of resonance structure. Low energy pion photoproduction is now almost completely understood in terms of pion-nucleon scattering. Strange-particle coupling constants were evaluated and shown to be consistent with pseudo-scaler SU(3). Several mathematical contributions to the study of dispersion relations were made. Author (TAB)

N68-23148# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Section.
U 235 FISSION PRODUCT DECAY ENERGY RELEASE RATES
J. M. Brunner and W. E. Edwards Dec. 1967 29 p refs
(Contract AT(40-1)-2847)
(GEMP-579)

Recent calculated and measured data were used to prepare revised graphs of fission product decay gamma energy release rate as a function of time between 1 and 10^8 seconds following instantaneous thermal ^{235}U fission and reactor operation from 1 minute to 1000 hours. Empirical expressions for fission product decay beta energy release rate were confirmed by recent measured data and were evaluated for the same operating and shutdown histories considered in the gamma analysis. Beta energy release rates, gamma energy release rates for seven energy groups, total gamma energy release rates, and the sum of the beta and gamma energy release rates are all presented graphically as a function of time after reactor shutdown. The total fission product energy release rates were reported previously in AFRPL-TR-65-196. The individual group data following reactor shutdown are included for use in detailed shutdown reactor-shield analyses. The release rates following instantaneous fission are included so that data may be generated for other reactor operating and shutdown histories as needed. Author (NSA)

N68-23155# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF THE PROPERTIES OF A SPONTANEOUSLY FISSIONABLE ISOMER Cf-246 [ISSLEDOVANIE SVOISTV SPONTANNO DELYASHCHEGOSYA IZOMERA CF-246]
Yu. P. Gangrskii, B. N. Markov, S. M. Polikanov, I. F. Kharisov, and Kh. Yungklaussen 1968 15 p refs In RUSSIAN Submitted for publication
(JINR-P7-3673)

Excitation functions of the reaction $^{238}U(^{12}C,4n)$, leading to a spontaneously fissionable isomer ^{246}Cf (half-life $\approx 5.10^{-8}$ sec) and to the ground state of ^{246}Cf, were investigated. The time-of-flight method of recoil nuclei, knocked out by the bombarding ions, was used in the experiment. From the comparison of the excitation functions, one can suppose that the energy of the isomeric state is comparatively large (>1 MeV). The cross-section ratio of ^{246}Cf production in isomeric and ground states equals 10^{-2}, what is considerably larger than in the case of the reactions leading to the Am isomers with mass number 238, 240, 242, and 244. Author (NSA)

N68-23163# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
MEASUREMENT OF THE DECAY OF A NEUTRON BURST IN SMALL BLOCKS OF BERYLLIUM AND BERYLLIUM OXIDE [IZMERENIE SPADA NEITRONNOGO IMPUL'SA V MALYKH BLOKAKH BERILLIYA I OKISI BERILLIYA]
I. F. Zherzherun 1967 24 p refs In RUSSIAN
(IAE-1362)

Experiments on the supplementary accurate measurement of the decay of neutron bursts in small blocks of Be and BeO with geometric parameters up to 0.1 cm^{-2}. The effect of the alteration of the experimental conditions (background level, different shields for the blocks, etc.) on the results was determined. The output of the neutron source and the detectors used made it possible to observe the decay of the neutron density on a range of four decades in time intervals from 0 to 1.5 to 2 msec. The decay constants were determined from measurements of the neutron density by the least squares method. Exponential decay was observed with significantly larger than λ_{lim}. Author (NSA)

N68-23164# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
A POSSIBLE METHOD OF TESTING THE QUASI-STATISTICAL CHARACTER OF NUCLEAR FISSION [OB ODNOI VOZMOZHNOSTI PROVERKI KVAZISTATICHESKOGO KHARAKTERA DELENIYA YADER]
V. A. Shigin 1967 8 p refs In RUSSIAN
(IAE-1389)

The results of a calculation of the mass distribution from ^{252}Cf at excitation energies of 6 and 21 MeV on the basis of the statistical approach to fission are reported. In contrast to the adiabatic approach, the statistical approach predicts for this nucleus a decrease of the mass yield in the area of symmetric fission with an increase of the excitation energy. Experiments with ^{252}Cf make it possible to establish which of these approaches appears to be accurate and also to explain whether fission appears at low excitation energies with the quasi-statistical processes.
Author (NSA)

N68-23232# Brown Univ., Providence, R. I.
SURVEY OF (N,Z) REACTIONS
R. A. Peck, Jr. Jun. 1967 21 p refs Presented at Symp. on Nucl. Phys. Res. with Low Energy Accelerators, College Park, Md., Jun. 1967
(Contract AT(30-1)-1082)
(NYO-1082-10; CONF-670615-4) CFSTI: HC $3.00/MF $0.65

A survey of nuclear research using (n,α), (n,d), (n,p), (n,t), and (n,He-3) reactions at neutron energies below about 20 MeV is presented. The information that was obtained on the reaction mechanisms and on nuclear parameters is summarized. NSA

N68-23301# University of Southern Calif., Los Angeles. Nuclear Physics Lab.
GENERAL NUCLEAR REACTION STRIPPING AND PICKUP COMPUTER PROGRAM Progress Report
William R. Smith 31 Aug. 1967 59 p refs
(Contract AT(04-3)-136)
(TID-24250; USC-136-133) CFSTI: HC $3.00/MF $0.65

A description and listing are presented on an optical-model DWBA program in which, for the case of stripping, the transferred particle is initially bound with $1=0$ in the bombarding particle by a central Hulthen potential and is bound in its final arbitrary-1 state to the target by a Woods–Saxon potential. Finite-range interactions and nonlocal potentials are included, but spin-orbit coupling is not. The program is written in standard FORTRAN. Author (NSA)

N68-23302# Aix-Marseilles Univ. (France). Faculte des Sciences.
CALCULATION OF RADIATIVE CORRECTIONS TO THE SIXTH ORDER INCLUSIVE FOR THE $\lambda^3\phi$ MODEL [CALCUL DES CORRECTIONS RADIATIVES JUSQU'AU SIXIEME ORDRE INCLUS POUR LE MODELE $\lambda^3\phi$]
Jacques Calmet (Ph.D. Thesis) 19 Dec. 1966 86 p refs In FRENCH
(NP-17207)

The λ^3_ϕ model, which although possessing formal analogies with electromagnetism does not have physical volume, was studied. The results of the study of the renormalization in functional formalism are presented with all of the results given in pulse space. The graphic method used and the writing of the first six approximations of the finite part of the functional generator of the propagators are reported. The calculations made by Soffer were redone and verified. The finite part of the contribution of the divergent graph of the second order is calculated and its most important properties determined. The contributions of the graphs pertaining to the third, fourth, fifth, and sixth orders are calculated. The principle used—iteration method of approximations—is developed for the fourth order and the steps were simply indicated. The results obtained are compiled and tabulated. NSA

N68-23303# Princeton Univ., N. J. Palmer Physical Lab.
QUARKS AND SYMMETRIES
H. J. Lipkin Sep. 1967 18 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg Sponsored in part by Higgins Sci. Trust Fund
(Contract AT(30-1)-937)
(PUC-937-285; CONF-670934-10) CFSTI: HC $3.00/MF $0.65

The discussion of quarks and symmetries covers the basic rules of the quark model, additivity applications, the axial vector mesons (K^*), the present status of SU(3), and that of higher symmetries. The experimental search for quarks is also reviewed. NSA

N68-23365# Hawaii Univ., Honolulu.
MESON AND BARYON RESONANCE PRODUCTION IN THE INTERACTION NEGATIVE PROTON YIELDS TWO NEGATIVE PIONS, POSITIVE PION AND NEUTRAL PION
Alfred D. Johnson (M.S. Thesis) Jan. 1968 39 p refs
(UH-511-18) CFSTI: HC $3.00/MF $0.65

Four thousand events fitting the five-body hypothesis $\pi^-p \rightarrow p\pi^-\pi^-\pi^+\pi^0$ were examined for resonance production using a maximum-likelihood method to fit the experimental data to a model of phase space weighted by Breit–Wigner functions. Parameters of the model are fractions of direct production of resonances (e.g., $\pi^-p \rightarrow \omega\pi^-p$) and cascade production (e.g., $\pi^-p \rightarrow A_2^0(1310)\ \pi^-p$, $A_2^0(1310) \rightarrow \rho\pi$). Masses and widths are not varied. Relative amounts of the important processes were determined and although no one process dominates, it appears that the processes $H_2^0(1000) \rightarrow \rho\pi$, $N(1520) \rightarrow \Delta(1236) + \pi$, and $N(2190) \rightarrow \Delta(1236) + \pi$ must be included to achieve a reasonable fit. Author (NSA)

N68-23366# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

PHOTOPRODUCTION OF NEUTRAL PION IN THE BACKWARD DIRECTION

G. Buschhorn (Hamburg Univ.), P. Heide (Hamburg Univ.), U. Koetz (Hamburg Univ.), R. A. Schmueser (Hamburg Univ.), and H. J. Skronn (Hamburg Univ.) Nov. 1967 7 p refs

(DESY-67/36)

The photoproduction of mesons (π^0) in the reaction $\gamma + p \rightarrow \pi^0 + p$ was investigated in the backward direction at photon energies from 0.8 to 5.5 GeV using a bremsstrahlung beam. The structure observed in the cross section implies that resonance contributions, if not dominant, are at least comparable with nonresonant contributions. Only $I=3/2$ resonances seem to contribute strongly. A shift in the position of the Δ (1920) and the Δ (2420) resonances which is of the order of $\Delta E_\gamma = 100$ MeV is noted. NSA

N68-23367# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

SPIN EFFECTS IN NEUTRAL KAON REGENERATION [SPINOVYE EFFEKTY V REGENERATSII NEUTRAL KAON MEZONOV]

L. I. Lapidus 1967 19 p refs In RUSSIAN; ENGLISH summary

(JINR-P2-3621)

The formulas usually used for K^0 regeneration on nuclei with spin $J \geq 1$ are changed due to spin dependence of the forward scattering amplitude. The definition of necessary quantities is given. Spin dependence exists in the amplitudes R, ρ and also in λ_1 and λ_2 The spin dependence of the forward scattering matrix for nuclei with spins 1 and 3/2, 2 and 5/2, 3 and 7/2 is given. The amplitude f is given. With the account of expansion for the spin density matrix one obtains the above mentioned values of nuclear spins. The expression for the total cross sections of interaction with aligned nuclei having spins 3 and 7/2 is given. Interference experiments after the regeneration on aligned targets is considered. The amplitudes are given. The expression for the two-pion decay are given. The change of the regeneration amplitude phase ϕ_ρ on aligned targets makes it possible to change the character of interference. The dependence of probabilities on $t_2 = \langle T^{20} \rangle$ (22) can have an extremum in which the amplitudes of strong and weak K^0 interactions become related. Expressions give the generalization of the obtained formulas for the case of nuclear spins equal to 3 and 7/2. The latter value of spin is especially interesting because it is equal to ^{165}Ho spin with the help of which targets with a noticeable degree of alignment were obtained at various laboratories. Even in the absence of the aligned target the existence of the amplitudes B, C... changes general formulas for regeneration. For nuclei with spins 1 and 3/2 one obtains expressions which are extended in the case of $t_2 \neq 0$. The generalization for the case of nuclei having higher spins is obvious. The Kobzarev–Okun experiment with two plates of different substances can be performed with plates of the same substance, but it is necessary to have, at least, one aligned plate. The change of the degree of alignment makes possible to change smoothly the regeneration properties of targets. The required formulas are given. Besides the weak interactions the study of spin effects in K^0 regeneration is useful for the investigation of spin dependence of strong interaction of K-mesons with nuclei. Author (NSA)

N68-23369# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

SPIN DEPENDENCE OF THE PHOTOPRODUCTION OF NEUTRAL RHO MESONS AT HIGH ENERGIES [ZUR SPINABHAENGIGKEIT DER PHOTOPRODUKTION VON NEUTRALEN RHOMESONEN BEI HOHEN ENERGIEN]

G. Kramer (Hamburg Univ.) Oct. 1967 13 p refs In GERMAN; ENGLISH summary

(DESY-67/32)

The hypothesis of spin independence for ρ^0 photoproduction is discussed in particular in connection with the strong-absorption model of Eisenberg and co-workers. Under this hypothesis, the ρ^0 mesons are produced with complete spin alignment in the direction of the photon momentum giving a particular simple spin density matrix of the ρ^0 in the Adair system. Author (NSA)

N68-23370# Joint Inst. for Nuclear Research, Dubna (USSR).

PHENOMENOLOGICAL ANALYSIS OF ELASTIC π+D→π+D SCATTERING [FENOMENOLOGICHESKII ANALIZ UPRUGOGO RASSEYANIYA π+D→π+D]

Doan Nhuong 1967 9 p refs In RUSSIAN

(JINR-P2-3619)

A complete set of measurements (of differential cross section and polarized deuteron effects in a final state) for a direct reconstruction of an elastic π+d→π+d scattering amplitude is suggested. Author (NSA)

N68-23393# Oak Ridge National Lab., Tenn.

WEAPONS RADIATION SHIELDING HANDBOOK, CHAPTER 3: METHODS FOR CALCULATING NEUTRON AND GAMMA RAY ATTENUATION

Paul N. Stevens and David K. Trubey Mar. 1968 118 p refs

(DASA Order EO-806-65)

(DASA-1892-3; AD-666973) CFSTI: HC $3.00/MF $0.65

Calculations of the attenuation of neutrons and gamma rays in shields can be performed by several techniques, the best technique for a particular problem depending on the type of problem to be solved and the degree of accuracy required. This chapter of the Handbook surveys the calculational methods used most frequently and provides summaries of digital computer codes based on the various methods. The methods covered are those of spherical harmonics, discrete ordinates, moments, Monte Carlo, diffusion theory, invariant imbedding, and kernels, plus a method which combines a removal kernel with diffusion theory. Except for the invariant imbedding method, all these techniques are either approximate solutions to the well-known Boltzmann equation or are based on kernels obtained from solutions to the equation. A discussion of the Boltzmann equation is also included in the chapter. Author (TAB)

N68-23420# Columbia Univ., Irvington, N. Y. Nevis Labs.

THE FORM FACTOR OF THE NEUTRAL PION

Peter Nemethy (Ph.D. Thesis) 1968 74 p refs

(Contract Nonr-266(72))

(NEVIS-165; R-617; CU-269; AD-666979)

In an experiment performed at Columbia University's Nevis Cyclotron, the decay neutral-pion to gamma photon + electron + positron was observed. Using a system of counters and spark chambers 2200 events were recorded with an opening angle of the Dalitz pair near 120 deg. The effect of pi-zero structure on the invariant mass spectrum of the pair is interpreted as an electromagnetic form factor for the neutral-pion. The form factor is a linear function, (gamma)(x) = 1 + ax, of the invariant mass squared, x. The experimental result for the form factor slope is a = (+0.01 plus or minus 0.11) (1/(pion mass)sq.). TAB

N68-23425# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

A REGGE POLE MODEL WITH ABSORPTIVE CORRECTIONS FOR THE REACTIONS $\pi^- + p \rightarrow \pi^0 + N$ AND $\pi^+ + p \rightarrow \pi^0 + \Delta^{++}$ [EIN REGGE-POL MODELL MIT ABSORPTIVEN KORREKTUREN FUER DIE REAKTIONEN $\pi^- + p \rightarrow \pi^0 + N$ UND $\pi^+ + p \rightarrow \pi^0 + \Delta^{++}$]

F. Schrempp Jan. 1968 103 p refs In GERMAN; ENGLISH summary

(DESY-68/1)

A Regge-pole model with absorptive corrections is presented for quasi-two-body reactions. It turns out that these corrections correspond to a cut contribution in the complex angular-momentum plane, with its branch point equal to the one resulting from

two-Regge-pole exchange. πN-charge exchange and the reaction $\pi^+ p \rightarrow \pi^0 \Delta^{++}$ (1238) are studied in greater detail. In the case of πN-charge exchange, the s- and t-dependences of the recoil-neutron polarization are predicted in a satisfactory manner, especially if one uses a complex absorption factor resulting from a three-Regge-pole fit to the elastic πN scattering data. The kinematical t-singularities and zeros of the helicity amplitudes are not determined by the commonly used method, i.e., by the aid of the crossing relation, but rather by comparing the ρ-Regge-pole amplitudes with the corresponding ρ-meson-pole graph at $t=m_\rho^2$. In the case of the reaction $\pi^+ p \rightarrow \pi^0 \Delta^{++}$ it is thus possible to isolate additional kinematical zeros at $t=0$ and $t=(m_\Delta - m_N)^2$. Taking these zeros into account leads to rather weakly varying residues between $t=0$ and $t=m_\rho^2$. The values of the residues determined from a fit to the data at $t=0$, favor the assumption of a dominating M1-transition at the $N\rho\Delta$-vertex. Accordingly, the Δ^{++}-density-matrix elements exhibit only a weak t-dependence in the pure Regge-pole model. However, the absorptive corrections make the density-matrix elements substantially more t-dependent in good agreement with the data. Author (NSA)

N68-23440 Stanford Univ., Calif.
SCATTERING THEORY FOR MAXWELL'S EQUATIONS IN AN EXTERIOR DOMAIN
Ernst Johannes Paul George Schmidt (Ph.D. Thesis) 1966 96 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4428

The purpose of this work was to treat the scattering of electromagnetic waves off obstacles within the framework of the scattering theory developed by Professor Peter Lax and Professor Ralph Phillips in their forthcoming book. This investigation runs parallel to, but is different from, their treatment of the acoustic wave equation. It accordingly involves: (1) the unperturbed problem—a discussion of Maxwell's equations in free space, (2) the perturbed problem—a discussion of Maxwell's equations in the exterior of an obstacle, and (3) scattering theory—in which the interplay between the perturbed and the unperturbed situations is developed. Dissert. Abstr.

N68-23488 Arizona Univ., Tucson.
DETERMINATION OF INTERMOLECULAR POTENTIAL PARAMETERS
Francis Anthony Bills (Ph.D. Thesis) 1966 186 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-1084

Partial scattering cross sections for thermal beams of Li^7, K and Cs attenuated in He, Ne, A, Kr and Xe have been measured as a function of the resolution of the apparatus using the molecular beam method. Absolute total scattering cross sections were determined by extrapolating curves of partial cross section vs. resolution to zero resolution. Intermolecular potential parameters for these interactions were calculated from the experimentally determined values of the absolute total scattering cross sections by using the Landau–Lifshitz scattering theory and assuming a long-range attractive van der Waals potential. A semi-empirical theory of resolution and multiple scattering was developed in order to account for the variation of partial scattering cross sections with resolution of the apparatus. This was accomplished by measuring the actual distribution of scattered intensity in the plane of the detector and also the total scattered intensity as a function of the pressure of the scattering gas. Dissert. Abstr.

N68-23489 California Univ., Los Angeles.
ELECTRON-ATOM COLLISIONS WITH POLARIZATION AND EXCHANGE EFFECTS INCLUDED
Peter Joseph Gingo (Ph.D. Thesis) 1966 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-550

A variational method is derived by which the elastic scattering cross sections for electron-atom collisions are calculated. The method includes the effects of the atomic polarization and electron exchange induced by the incident electrons. The variational method was applied to the s-wave hydrogen-electron scattering and oxygen-electron scattering problems. This present variational method was then applied to the oxygen-electron scattering with the incident electron energy ranging from 0.02 to 0.7 atomic units. These calculations were made with the hydrogen-like orbital wave functions for the oxygen as given by R. G. Breen Jr. and also with Hartree–Fock tabulated orbital wave functions. Dissert. Abstr.

N68-23503 Yale Univ., New Haven, Conn.
PHOTOPRODUCTION OF LEPTONS AND MESONS
Peter Kitching (Ph.D. Thesis) 1966 227 p
Available from Univ. Microfilms: HC $10.35/MF $3.00 Order No. 67-100

The experiment described in this Thesis was undertaken as an exploratory investigation of photon-induced reactions at energies in the BeV region. The photoproduction cross sections of electrons, muons, π-mesons and K-mesons were observed. Particles were produced on hydrogen and carbon targets by a bremsstrahlung beam from the accelerator and momentum analyzed with a magnetic spectrometer. Their velocity was determined by means of differential gas Cerenkov counters. Electron and muon measurements, which are of interest in investigating the validity of Quantum Electrodynamics at high momentum transfers, were carried out with particle momenta of 2.0 BeV/c, and laboratory production angles of 4.5° and 7.5° on carbon, and 5° on hydrogen. The electron measurement at the highest value of the momentum transfer appeared to disagree with the prediction of Quantum Electrodynamics. The results of the muon measurements were in agreement with the prediction of Quantum Electrodynamics. Dissert. Abstr.

N68-23511*# Techtran Corp., Glen Burnie, Md.
MECHANISM OF INTERACTION OF FAST DEUTERONS WITH NUCLEI [MEKHANIZM VZAIMODEYSTVIYA BYSTRYKH DEYTRONOV S YADRAMI]
V. S. Barashenkov, K. K. Gudima, and V. D. Toneyev Washington NASA May 1968 14 p refs Transl. into ENGLISH from Russian Rept. JINR-P2-3356
(Contract NASw-1695)
(NASA-TT-F-11674; JINR-P2-3356) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A method of calculation of inelastic collisions of deuterons with nuclei is suggested. The calculation is made by the Monte Carlo method, taking into account the Coulomb and diffraction-deuteron splittings. The results of calculations agree well with the experiment. Author

N68-23532 California Inst. of Tech., Pasadena.
PHOTOPRODUCTION OF CHARGED PION PAIRS FROM HYDROGEN AT ENERGIES UP TO 1500 MeV
Lyman Jefferson Fretwell, Jr. (Ph.D. Thesis) 1967 262 p
Available from Univ. Microfilms: HC $11.95/MF $3.40 Order No. 67-191

Charged pion pair photoproduction has been investigated up to a gamma energy of 1500 MeV, using the Caltech 12-inch heavy liquid bubble chamber with a small diameter, high intensity photon beam passing through a central beam tube gaseous hydrogen target surrounded by the sensitive freon. Scanning, analysis, and data reduction techniques have been developed to deal with the problems of two-view stereo, hidden event origins, absence of magnetic field, and the range-energy and multiple scattering relationships that occur in the heavy materials. Roughly 5700 pictures have been scanned and analyzed, yielding 754 acceptable events. Cross section and parameter distributions are generally consistent with the results of previous experiments. A statistically insignificant bump was observed in the dipion mass spectrum in the region of 400 MeV, the disputed σ meson mass. This region was investigated as carefully as the limited statistics would allow;

dipion angular distributions are consistent with isotropy, and there is indication that some of the events in this region might come from decay of an intermediate $N^*_{11}(1425)$ into a proton and dipion. Dissert. Abstr.

N68-23543# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
YIELDS FROM NEUTRON INDUCED FISSION
I. F. Croall Jan. 1968 31 p refs
(AERE-R-5086) HMSO: 4s 6d

A survey of yields from the thermal and fast neutron induced fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu, and from the fast neutron fission of ^{232}Th and ^{238}U has been made. Author

N68-23554 Florida State Univ., Tallahassee.
AN ANALYSIS OF RHO MESON PRODUCTION AND DECAY IN NEGATIVE PION PROTON INTERACTIONS AT 2.26 BeV/c
Bruce Grahlmann Reynolds (Ph.D. Thesis) 1966 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-329

A liquid hydrogen bubble chamber investigation of π^--proton interactions has been carried out at a momentum of 2.26 BeV/c. The chamber used for this experiment was the 72 inch Alvarez bubble chamber at the University of California Lawrence Radiation Laboratory. A total of 9,228 two-prong events have been measured and the partial cross sections for non-strange final states have been determined. The three-body final states are found to be dominated by ρ meson production. In any charge state, isobar production is very small. The production and decay of the ρ meson is analyzed in terms of the one-pion-exchange (OPE) model and in terms of the one-pion-exchange model modified to include absorption (OPEA). The elements of the ρ meson spin-space density matrix are measured and a discussion of the neutral ρ anomaly is given. Dissert. Abstr.

N68-23587# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
SHORT RANGE DYNAMICAL CORRELATIONS IN THE C12 NUCLEUS FROM ELASTIC ELECTRON SCATTERING
C. Ciofi Degli Atti 30 Dec. 1967 10 p refs
(ISS-67/49) CFSTI: HC $3.00/MF $0.65

The elastic electron form-factor of the ^{12}C nucleus is computed using harmonic oscillator wave functions and Jastrow-type correlations. The best fit oscillator lengths are sensibly state dependent and agree with those found in (e,e'p) reaction. Author

N68-23606 North Carolina Univ., Chapel Hill.
DIFFERENTIAL CROSS SECTIONS FOR $C^{12}(d,p_1)C^{13}$ AND $B^{10}(d,p)B^{11*}$ AT ENERGIES BELOW 3 MeV
Emery Ray Vaughn Poore, Jr. (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-1041

A study of the $C^{12}(d,p_1)C^{13}$ (3.09 MeV state) has been made at bombarding energies between 0.900 and 2.10 MeV. Angular distributions were measured both on and off resonances in the yield curve for eleven bombarding energies. The angular distributions at E_d 1.690, 1.452, 1.320 and 0.900 MeV show the effect of resonances near these energies. Angular distributions for the $B^{10}(d,p)B^{11}$ reactions leaving B^{11} in the fourth, sixth, seventh, eighth, ninth, tenth and eleventh excited states have been measured at six bombarding energies between 1.75 and 3.00 MeV. Proton yield curves at $\theta_{LAB}=90°$ were obtained for bombarding energies between 1.42 and 3.10 MeV. No strong resonances are apparent in the yield curves. Plane wave, DWBA and Coulomb wave fits have been attempted and a comparison is made of the resulting absolute reduced widths and spectroscopic factors. An examination of PWBA fits versus Q-value and bombarding energy has been made. Dissert. Abstr.

N68-23612 Minnesota Univ., Minneapolis.
SEPARABLE POTENTIALS FOR THE TWO-NUCLEON SYSTEM
James John Mac Kenzie (Ph.D. Thesis) 1966 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-21

Expressions are derived for non-local separable potentials which will reproduce (with stated restrictions) the two-body scattering phase shift and bound state energy. The quantity, sin δ, is required to be of one sign only. If the phase shift changes sign, more than one separable potential is required. To handle this situation a model employing one attractive and one repulsive potential is introduced, and a one-parameter family of solutions is obtained. Tensor forces are treated by the introduction of a non-local separable interaction which connects different values of angular momenta. The bound state wave function is found in terms of the scattering data and bound state energy. The results of numerical calculations for the singlet and triplet S waves of the nucleon-nucleon system are presented and discussed. Dissert. Abstr.

N68-23613 North Carolina Univ., Chapel Hill.
THE INTERACTION OF HEAVY IONS WITH M-SHELL ELECTRONS
Govind Sharan Khandelwal (Ph.D. Thesis) 1966 36 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-1011

This thesis extends to the M-shell the calculation of the cross section for the removal of an inner shell atomic electron by bombardment with protons or other heavy ions. The Bethe–Born approximation was applied to calculation of an M-shell form factor which is useful in expressing the ionization cross section and the stopping number for heavy charged particles. The atomic electrons were described by hydrogenic wave functions, and their use is probably the chief weakness of the work. The M-shell results are compared with similar results known previously for the K- and L-shells. The possibility of extending such calculations to higher atomic shells, using more realistic wave functions, is indicated. Dissert. Abstr.

N68-23651# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
CP-VIOLATING WEAK CURRENTS
L. Maiani 20 Jan. 1968 12 p refs
(ISS-68/3) CFSTI: HC $3.00/MF $0.65

We discuss a theory in which CP is violated through second class axial currents. These currents are given a suitable algebraic structure so as to maintain the leptons-hadrons symmetry in leptonic processes. PC-violations are then described by a universal angle ϕ, to be determined from experiments. Implications for leptonic and nonleptonic processes are discussed. Author

N68-23655 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
RADIAL ACCEPTANCE OF 10 MEV PROTON LINEAR ACCELERATOR IN SWIERK [AKCEPTANCJA RADIALNA LINIOWEGO AKCELERATORA PROTONOW 10 MEV W SWIERKU]
Eugeniusz Dziura 1967 23 p refs Transl. into ENGLISH from Polish
(IBJ-834/SLBAL/PL) CFSTI: $3.00

In order to find the input data for the calculation of the optical beam matching system between the 0.5 MeV Cockroft–Walton injector and 10 MeV proton linear accelerator in Swierk, three alternatives of focusing system arrangements have been calculated. The (0+−++...) arrangement is shown as only applicable. For the chosen quadrupole field strength law and with the rigorous assumption that the magnetic lengths of the lenses are equal to their geometrical lengths the following numbers were obtained: cos $\theta=0.788$ and $F=70$ mrad mm. Author

N68-23656 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE NUMERICAL PROGRAM OF THE DIAGONALIZATION OF THE NILSSON MODEL IN GIER-ALGOL [PROGRAM NUMERYCZNEJ DIAFONOALZACJI MODELU NILSSONA W JEZYKU GIER-ALGOL]
M. Zielinska-Pfabe and W. Grochulski 1967 20 p refs Transl. into ENGLISH from Polish
(IBJ-854/VII/PL) CFSTI: $3.00

The description of the numerical computation program for a diagonalization of the Nilsson model of atomic nucleus is given. The computation contains two cases: The old Nilsson model and a slightly modified version suggested recently. The calculation is limited to the case of axial symmetry. The eigenvectors and eigenvalues can be obtained for any quadrupole and hexadecapole deformation. Both programs are written in GIER-ALGOL. Author

N68-23668# Brookhaven National Lab., Upton, N. Y. Information Div.
EFFECTIVE MOMENTS OF INERTIA OF HEAVY NUCLEI AT THE SADDLE POINT
S. A. Karamyan et al Feb. 1968 24 p refs Transl. into ENGLISH from Yadern. Fiz. (USSR), v. 6, 1967 p 494–504
(BNL-TR-192) CFSTI: HC $3.00/MF $0.65

The angular distributions of fission fragments were investigated by irradiating targets of ^{197}Au, ^{209}Bi, and ^{238}U with accelerated ^{12}C, ^{14}N, ^{16}O, and ^{22}Ne ions with energies of 6 to 8 MeV/nucleon. The angular dependence of the elastic scattering cross section was measured for every combination of target and particle and for every energy of bombarding ions. The partial cross sections of compound-nucleus production were determined from the elastic scattering data. Using these cross sections, the effective moments of inertia of nuclei with Z^2/A from 35 to 40 were calculated on the basis of the statistical model. It is shown that the quantity J_{eff} within the accuracy of the experiment depends only upon Z^2/A and is independent of the nuclear temperature. $(Z^2/A)_{crit}$, which was obtained from the extrapolation of experimental data, lies within 45 to 47. Author (NSA)

N68-23671# Pittsburgh Univ., Pa. Wherrett Lab. of Nuclear Chemistry.
NUCLEAR CHEMISTRY RESEARCH: RECOIL STUDIES OF NUCLEAR REACTIONS Annual Report, Jan. 1967–Jan. 1968
Robert L. Wolke Jan. 1968 61 p refs
(Contract AT(30-1)-2771)
(NYO-2771-25) CFSTI: HC $3.00/MF $0.65

Research progress on the charge states of recoils from nuclear reactions, recoil spectrometry of (d,n) reactions, and the dating of lead-bearing objects is reported. NSA

N68-23686 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ASYMMETRY MOMENTS OF ANGULAR DISTRIBUTIONS [MOMENTY ASYMETRII W ROZKLADACH KATOWYCH]
P. Kielanowski and J. Werle 1967 12 p refs Transl. into ENGLISH from Polish
(IBJ-868/VII/PH) CFSTI: $3.00

The conventional harmonic analysis of the experimental angular distribution function requires cumbersome integrations with suitable weight functions. A much simpler analysis of the experimental data is proposed with the help of asymmetry moments. It is shown that the value of a suitable asymmetry moment may be used as a parity or spin test. Author

N68-23708# Paris Univ., Orsay (France). Institut de Physique Nucleaire.
ISOSPIN AND NUMBER-CONSERVING TREATMENT OF PAIRING CORRELATIONS IN NUCLEI
X. Campi, H. Vucetich, and M. Jean Nov. 1967 29 p refs
(IPNO/TH-110)

A previous study of the pairing interaction between identical particles by means of the equations of motion is extended to the case of unlike nucleons interacting through a charge-independent force. By comparison with the Hecht model for which exact numerical results are available, the results are seen to be a compromise between those of the BCS and Lipkin–Nogami methods. Author (NSA)

N68-23709# Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies.
CURRENT ALGEBRA AND K^+-K^0 MASS DIFFERENCE
F. Capra Oct. 1967 12 p refs
(LPTHE-TH-221)

Using the spectral function sum rules of Weinberg and the soft meson technique, the electromagnetic mass splitting of the kaons is calculated. It is shown that the essential contribution comes from σ-terms which can be evaluated with the help of the σ model and of the tadpole theory of Coleman and Glashow. The result depends on the unknown mass of the scalar isoscalar meson σ_B. Identification of the resonance ϵ (700) with this meson gives a mass difference of $\delta m_K = -3.55 \pm 2.71$ MeV in good agreement with experiment. Author (NSA)

N68-23718# United Kingdom Atomic Energy Authority, Wantage (England). Research Group.
GAMMA-RAY BRANCHING RATIO IN THE DECAY OF Zr^{95}
J. E. Hiscott Jan. 1968 11 p refs
(AERE-R-5342) HMSO: 2s 6d

An investigation was made of the gamma ray spectrum of Zr^{95}/Nb^{95} using a lithium drifted germanium detector, with the object of determining the intensities of the 724 and 756 keV transitions in the decay of Zr^{95}. Since the 764 keV transition in Nb^{95} was not completely resolved, a mathematical analysis of spectra, obtained over several weeks from materials with differing Zr:Nb ratios, was made, and measurements on chemically separated Zr were studied. The intensity of the 724 keV transition was determined to be 43.5% and of the 756 keV transition to be 54.5%. Author

N68-23734# Technische Hochschule Stuttgart (West Germany). Institut fuer Kernenergetik.
CONTRIBUTIONS TO THE CALCULATION OF THE SCATTERING OF FAST NEUTRONS IN U-238 [BEITRAEGE ZUR BERECHNUNG DER STREUUNG SCHNELLER NEUTRONEN AN U-238]
F. Buehler and F. Schmidt 1 Dec. 1967 82 p refs In GERMAN; ENGLISH summary Supported in part by Bundesmin. Wiss. Forsch.
(BMwF-FBK-67-90)

The separation of the compound-nucleus cross section 6. is considered by the theories of Hauser and Feshbach and P.A. Moldauer. For the example ^{238}U two sets of optical-model parameters are given such that the measured values of the total cross section σ_{tot} and the nonelastic cross section σ_x agree well with the values calculated by the optical model in connection with both theories. It is found that only the cross sections of compound elastic scattering σ_{nn} show substantial differences. So far practical uses it seems to be sufficient to predict cross sections of inelastic scattering by the theory of Hauser and Feshbach. It is found that evaluations with the evaporation model agree better with experimental values if σ_c is calculated by the theory of Moldauer. Elastic scattering and inelastic direct processes of fast neutrons on ^{238}U are discussed. For this, a deformed optical potential is used. Its form factors are fixed by generalization of the equivalent local potential of Percy and Buck (1962). A spherical spin-orbit potential is added. The target nucleus is described with the collective model. Author (NSA)

N68-23735# Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies.

ON SOME SINGULARITIES OF THE REGGE POLE MODEL AT MASS ZERO

R. Omnes Nov. 1967 9 p refs
(LPTHE-TH-228)

The behavior of a Regge pole expansion when the mass of a physical particle tends to zero is considered. If this variation of the mass is obtained by letting some parameter λ vary, it is found that the analytic form of the residues must change discontinuously when the mass passes through zero. Such an effect is called a transition, by analogy with statistical mechanics. Some consequences are given, concerning the reliability of perturbation expansion, zero mass pions and their Toller classification, the Pomeranchuk singularity. Author (NSA)

N68-23749 Louisiana State Univ., Baton Rouge.

ON HIGH ENERGY ELASTIC SCATTERING

Garabed A. Armoudian (Ph.D. Thesis) 1966 59 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-1145

The results of the partial wave analysis of π-p and p–p scattering in Bev energy ranges are reviewed, and it is pointed out that these results suggest a saturated Gaussian distribution of the inelastic collision matrix elements squared. The large angle p–p scattering is analyzed in terms of effective potentials. Analysis of Orear's empirical formula indicates the possible forms of the potentials. The potentials are characterized by their regularity at the origin. Similar potentials are derived from Markov's modified field theory. The results from the potential approach and Markov's theory are compared with experiment. Among the possible interaction models, the simplest one, scalar interaction gives the best result in both cases. From such analysis a semi-empirical formula is obtained which reproduces the experimental results very precisely. Physical interpretations of Markov's theory are also discussed. Dissert. Abstr.

N68-23751 Florida Univ., Gainesville.

EXCITED NUCLEAR STATES OF SULFUR AND ARGON PRODUCED BY 3-4 MeV ALPHA PARTICLES

Patrick Nelson Carlton (Ph.D. Thesis) 1966 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-356

Radiative alpha capture has been studied in silicon and sulfur. The relative ease of assigning spins and parities through (α,γ) spectroscopy of even-even nuclei has been pointed out. The University of Florida 4 MeV Van de Graaff accelerator was used to produce singly ionized He^4 in the 3-4 MeV range at 2 microamperes average currents. Targets of SiO_2, both natural and Si^{28}-enriched (>98%), natural ZnS, and S^{32}-enriched (>98%) elemental sulfur were evaporated onto 0.004 in. thick copper backings. Spins and parties, where assigned, were determined from angular distributions of the gamma rays taken at the resonances. It is noted that for self-conjugate nuclei in the mass region investigated, the isobaric spin selection rule is effective for E1 transitions. Dissert. Abstr.

N68-23754 Ohio Univ., Athens.

AN OPTICAL-MODEL INVESTIGATION OF ELASTIC NEUTRON SCATTERING

Robert Louis Cassola (Ph.D. Thesis) 1966 198 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-1216

In this investigation we first consider some of the basic ideas relating to nuclear reactions and examine the role which the complex-potential model plays in the description of the elastic scattering process. Armed with these qualitative ideas we then proceed to a discussion of some of the more formal aspects of the theory. The implementation of the complex-potential model is discussed and the specific goals of the present investigation are enumerated. A detailed discussion is given of the experiments which were analyzed in this study and points out those features of the complex-potential model which are firmly established by the present analysis. A discussion of those aspects of the model for which the results of the present investigation are ambiguous is included. A new approach to the problem of elastic scattering from a complex, non-local potential is presented. It is shown that a closed-form expression for the scattering phase shifts can be obtained if the scattering potential is assumed to be separable. Dissert. Abstr.

N68-23755# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

THE DATA ON THE ELASTIC p–p AND p–d SCATTERING AT SMALL ANGLES AND THE REAL PART OF THE p–n SCATTERING AMPLITUDE IN THE ENERGY RANGE 1 TO 10 GEV [ITOGOVYE DANNYE PO UPRUGOMU p–p I p–d RASSEYANIYU NA MALYE UGLY I VESHCHESTVENNAYA CHAST AMPLITUDY p–n RASSEYANIYA V INTERVALE ENERGII 1–10 GEV]

N. Dalkhazhav, P. Devinski, V. Zayachki et al 1967 14 p refs In RUSSIAN
(JINR-P1-3641)

The tables of differential cross sections of the elastic p–p and p–d scattering in the energy range 1–10 GeV, and the specified data on the value of the real part of the p–n scattering amplitude in the energy range 1–10 GeV after the increase of statistics are given. The value of the real part is calculated on the basis of Glauber deuteron model. The experimental results are compared with the predictions, resulting from the dispersion relations for the scattering amplitude at t=0, following from the general principles of the quantum field theory. The real part of the p–n scattering amplitude, obtained in the experiment, is compared with the data on n–p charge-exchange. Author (NSA)

N68-23757# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ASYMPTOTIC EQUALITY OF THE CROSS SECTIONS OF NEUTRINO AND ANTINEUTRINO INTERACTION WITH A NUCLEON [ASIMPTOTICHESKOE RAVENSTVO SECHENII VZAIMODEISTVIYA NEITRINO I ANTINEITRINO S NUKLONOM]

Nguyen Thi Hong 1967 16 p refs In RUSSIAN
(JINR-P2-3647)

Asymptotic equality of the cross sections of multiple hadron production by neutrino and antineutrino collisions with the nucleons is established. This equality is a consequence of analyticity of the amplitudes of the virtual Compton effact type and of a rather probable assumption on the behavior of these cross sections at high energies. Author (NSA)

N68-23774# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

CURRENT ALGEBRA, 1 [ALGEBRA DELLE CORRENTI, 1]

L. Maiani and G. Preparaja (Rome Univ.) 20 Sep. 1967 48 p refs In ITALIAN; ENGLISH summary
(ISS-67/31) CFSTI: HC $3.00/MF $0.65

A review is presented on the most important results obtained from the algebra of currents introduced by Gell-Mann. It includes a detailed discussion on the derivation of sum rules (Adler-Weisberger, etc.), either with the $p \to \infty$ method or with the covariant method. Author

N68-23775# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

CURRENT ALGEBRA, 2 [ALGEBRA DELLI CORRENTI, 2]

L. Maiani and G. Preparata (Rome Univ.) 20 Sep. 1967 55 p refs In ITALIAN; ENGLISH summary
(ISS-67/32) CFSTI: HC $3.00/MF $0.65

This is a review paper on the most important results obtained from the Algebra of currents introduced by Gell–Mann. It includes a detailed discussion on the derivation of sum rules, Cabibbo–Radicati, etc.), either with the p→∞ method or with the covariant method. Theorems for the emission of zero energy pions are also discussed, and applied to leptonic and nonleptonic decays of K mesons. Author

N68-23783 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SIX PRONG INTERACTIONS OF 16 GEV/C π^- WITH PROTONS [SZESCIORAMIENNE ODDZIALYWANIA NEGATIVE PION O PEDZIE 16 GEV/C Z PROTONAN]
K. Boeckmann (Bonn Univ.), H. Drevermann (Bonn Univ.), K. Sternberger (Bonn Univ.), N. Stief (Bonn Univ.), T. Hofmoki et al 1967 13 p refs Transl. into ENGLISH from Polish
(IBJ-837/VI/PH)

About 4000 six-prong interactions of 16 GeV/c π^- with protons recorded in the 2m CERN hydrogen bubble chamber were measured. Cross sections for fitted channels are given. In the reaction $\pi^- p \rightarrow p\,2\pi^+ 3\pi^-$ copious production of N^{*++} (1236) (≈35 c/o) and ρ^0 (≈60 o/o) is observed. In the reaction $\pi^- p \rightarrow p\,2\pi^+ 3\pi^- \pi^0$ the N^{*++} (1236) production is weaker, but there is good evidence for ρ^0 (≈30 c/o) and ω^0 (≈15 o/o) production. Single particle distributions are discussed as well as the Goldhaber effect. Author

N68-23788# Atomic Energy Commission Research Establishment, Riso (Denmark).
AEK SHIELDING PROGRAMMES P-18, 19, 20, 63, 220, 374—USER'S MANUAL
Peter Kirkegaard 12 Dec. 1967 112 p refs Supersedes RISO-M-491
(RISO-M-663; RISO-M-491)

Detailed instruction is given in the use of the series of shielding programs, developed at Risö since 1963: PRIGAM, SEGAM I, SEGAM II, REMTHERM, MC4, and REMDIFF. The present report replaces Risö-M-491. Author (NSA)

N68-23844 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANGULAR CORRELATIONS BETWEEN PIONS IN TEN-PRONG π^+ POSITIVE INTERACTIONS AT 8 GEV/C PRIMARY π^+ MOMENTUM [KORELACJE KATOWE POMIEDZY MEZONAMI PI W 10-CIO SLADOWYCH ODDZIALYWANIACH POSITIVE PION P PRZY PEDZIE POSITIVE PION 8 GEV/C]
Andrzej Eskreys and Halina Wolek 1967 12 p refs Transl. into ENGLISH from Polish
(IBJ-876/VI/PH) CFSTI: $3.00

The strong angular correlations between pions were found in a 10-prong π^+-p interactions at 8 GeV/c. The average opening angle of pion pair of like charges is smaller than that for pairs of unlike pions. This effect appears to be stronger in 10-prong interactions than in 8-prong interactions and much stronger than in 6-prong interactions at the same incoming momentum. Author

N68-23848*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
DISTRIBUTION OF MODERATED AND UNMODERATED 14-MEV NEUTRONS IN A SEMI-INFINITE SAMPLE ALONG AN AIR-GROUND INTERFACE
Y. Eden, J. I. Trombka, F. Senftle (Geol. Surv., Washington, D. C.), P. Sarigianis (Geol. Surv., Washington, D. C.), and P. Philbin (Geol. Surv., Washington, D. C.) May 1968 20 p refs
(NASA-TM-X-63205; X-641-68-157) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A moderated and an unmoderated source of 14-Mev neutrons were used to irradiate a semi-infinite sample of ground. The neutron number and energy distribution were measured with ten BF_3 neutron counters at various distances up to 150 feet. Distribution curves are shown for both thermal and fast components. A peak was observed in the fast component curve, which is explained as an effect of spectrum softening with distance from the source. Author

N68-23868# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research.
SOME FEATURES OF NEUTRAL PION PRODUCTION IN INTERACTIONS OF 9 GEV NEGATIVE PIONS WITH XENON NUCLEI
T. Siemiarczuk 1967 14 p refs
(INR-P-844/VI/PH)

The energy and angle of emission of 3271 photons emitted in 1374 Π^--Xe interactions at 9 GeV were measured and the process leading to Π^0 production is discussed. Author (NSA)

N68-23887# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
ATTENUATION OF FAST NEUTRONS IN UNIFORM MEDIA
M. Copic Feb. 1968 5 p refs Presented at the Deut. Atomforum E.V.8 Reactor Theory Meeting, Munich, Mar. 1968
(NIJS-R-520)

Multigroup diffusion or removal-diffusion models were used for an approximation analysis of fast neutron attenuation in uniform media. The problem is solved by Fourier transform of the inhomogeneous multigroup transport equation in plane geometry. Because the dispersion function is a lower triangular matrix, the inverse integral transformation is performed by contour integration and the imbedded eigenvalues give contributions in off-diagonal elements due to residua across the cut. G.G.

N68-23893*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
CALCULATION OF CAPTURE CROSS SECTIONS FOR ION POLAR MOLECULE COLLISIONS INVOLVING METHYL CYANIDE
John V. Dugan, Jr., James H. Rice, and John L. Magee (Notre Dame, Univ.) Washington May 1968 19 p refs
(NASA-TM-X-1586) CFSTI: HC $3.00/MF $0.65 CSCL 07E

The cross sections (CS) for capture collisions between the symmetric top molecule CH_3CN and molecular ions are calculated numerically. These ion-molecule collisions were studied experimentally and have large reaction CS, Q_R. Calculations are done to study the role of the added degree of rotational freedom by comparing capture CS for tops with linear molecules. The monoenergetic CS $\sigma_c(\epsilon_1)$ (where ϵ_1 is the ion energy and T_R is the top rotational temperature) are less than the maximum classical CS σ_{max}, but much larger than Langevin CS σ_L. The integrated σ_c, Q_c, agree well with Q_R for the collisions studied. The σ_c values for CH_3CN are nearly independent of target geometry. Author

N68-23924 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
THE DECOUPLET EXCHANGE SUPERCONVERGENCE RELATIONS FOR MESON BARYON-SCATTERING AND CUTS IN THE COMPLEX J-PLANE [REGULY SUPERZBIEZNOSCI ZWIAZANE Z WYMIANA DEKUPLETU DLA ROZPRASZANIA MEZON BARION I CIECIA NA PLASZCZYZNIEJ]
Jan Kwiecinski Feb. 1968 14 p refs Transl. into ENGLISH from Polish Submitted for publication
(INP-592/PH) CFSTI: $3.00

The possible superconvergence relations are studied for that part of the meson baryon scattering amplitude which corresponds to the exchange of the decouplet in the t-channel. It has been found that the superconvergence relations cannot be satisfied by the respective two invariant amplitudes separately but only by their

combination, which for t=0 corresponds to the forward scattering amplitude. This fact is explained in terms of cuts in the complex j-plane. Author

N68-23926# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
AN APPLICATION OF THE SATZ SUM RULES TO THE HIGH MULTIPLICITY PROCESSES [ZASTOSOWANIE MODELU SATZA DO PROCESOW WYSOKIEJ KROTNOSCI]
T. Hofmokl and M. Szeptycka 1968 13 p refs Transl. into ENGLISH from Polish Submitted for publication
(IBJ-881/VI/PH) CFSTI: HC $3.00/MF $0.65

The relation which follows from the Satz [1,2] additive quark model between cross-sections for the reactions $\pi p \rightarrow N(k+1)\pi$ and $pp \rightarrow NN\ k\ \pi$ is found to be in agreement with experimental data for k=4 and k=5. Author

N68-23968# Michigan Univ., Ann Arbor. Dept. of Physics.
SIMPLE SHELL MODEL EXPRESSIONS FOR COULOMB ENERGIES Technical Report
K. T. Hecht Feb. 1968 17 p refs
(Contract Nonr-1224(59))
(AD-667737)

It is shown that the main n, T-dependent terms of the Coulomb energy have the same general form in the Wigner supermultiplet scheme as in the low seniority limit of the j-j coupling scheme of the shell model. Author (TAB)

N68-24035 Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
APPROACH TO THE THREE-BODY SCATTERING PROBLEM
John R. Jasperse Dec. 1967 19 p refs *Its* Phys. Sci. Res. Papers, No. 347
(AFCRL-67-0673; AD-667212)

The partial wavefunction approach to the three-body scattering problem is used to derive some new equations for the wavefunction. All scattering processes are solutions of inhomogeneous coupled integral equations for the scattered parts of the total wavefunction. The Pauli principle is incorporated when two or all of the particles are identical. This leads to a reduction in the number of independent scattered partial wavefunctions when two or all of the particles are identical. The kernels in the integral equations contain no delta functions but each scattered partial wavefunction does have a selfcoupling term. Applied to the scattering of three identical bosons interacting through zero-range pair potentials, the method gives the same equation as obtained by the Faddeev T-matrix approach. Author (TAB)

N68-24059# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUATIONS FOR VERTEX PARTS AND BOUND STATES [URAVNENIYA DLYA VERSHINNYKH CHASTEY I SVYAZANNYYE SOSTOYANIYA]
M. A. Braun *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 3–13 refs (See N68-24058 13-06)

The system of dispersion theoretic equations for the vortex parts π NN and NND with a nucleon off the mass shell is studied in the low energy region in the spinless particle model. The anomalous threshold is calculated by analytic continuation in the mass variable. Under the assumption that the deuteron is a bound state of the nucleons, an equation is obtained for the determination of its mass. Author

N68-24060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASSOCIATING OF NUCLEONS IN NUCLEI [ASSOTSIIROVANIYE NUKLONOV V YADRAKH]
B. Ye. Bunakov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 15–23 refs (See N68-24058 13-06)

The connection between the probable existence of nuclear clustering and quantum numbers, characterized by irreducible group representations of commutation and orthogonal groups (forming shell-model wave functions of a nucleus) has been investigated. The relation between the S-state of the two-nucleon relative motion and the seniority quantum number v of its shell-model wave function has been studied. For v=0 the state of the two-nucleon can be represented by the S-state. A similar analysis is made for the case of n nucleons. It is shown that classification by the quantum number [f] and ω can appear at the same time as an S-state nucleon weight classification in relative motion. An experimental regularity is found to be present in the values of binding energies of light nuclei, which assumes the existence of two-, three-, and four-nucleon clusters. The method under consideration makes it possible to treat double, triple, and quadruple nucleon correlations on the basis of the same effective two-body interactions of nucleons. A physical interpretation is given for the experimental facts concerning energy advantage of states with the lowest seniority and isotopic spin. Author

N68-24061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEAR-THRESHOLD BEHAVIOR OF THE INELASTIC SCATTERING CROSS SECTION [OKOLOPOROGOVOYE POVEDENIYE SECHENIYA NEUPRUGOGO RASSEYANIYA]
T. V. Zhikhareva *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 25–30 refs (See N68-24058 13-06)

The partial cross-section transition from the 1-channel to the i-th channel for complete orbital momentum L is given. A three-channel case is considered, and the resonance effect in the inelastic cross section σ_{12} is also considered. The nature of the inelastic cross section σ_{12} anomaly near the threshold $K_3=0$ is studied, and it is shown that the greater the probability of inelastic processes σ_{13} and σ_{23} the greater will be the anomaly in the threshold $K_3=0$ of inelastic cross section σ_{12}. The behavior of p-wave inelastic cross section σ_{12} near the threshold of secondary inelastic reaction is investigated. Author

N68-24062# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUCLEAR-RESONANCE GENERATOR WITH FLOWING LIQUID [YADERNO REZONANSNYY GENERATOR S TEKUSHCHEY ZHIDKOST'YU]
F. I. Skripov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 31–62 refs (See N68-24058 13-06)

The theory of the operation of the nuclear resonance generator is discussed. Processes in magnetization and cohering coils are considered, and the characteristics of the generator in the narrowband filter regime are given. Author

N68-24063# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIATION OF Sb^{125} [IZLUCHENIYE Sb^{125}]
N. M. Anton'yeva and G. S. Katykhin *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 63–69 refs (See N68-24058 13-06)

The β-spectrum and the spectrum of conversion electrons of Sb^{125} have been studied with the help of a magnetic spectrometer with 0.5% resolving power and a magnetic spectrograph with 0.15% resolution. Investigation was conducted on a single source specimen, chemically separated and neutron irradiated. Among the various Sb^{125} measurements conducted were: the β-spectrum, K and L conversion spectra, γ-radiation energy, multipole order transitions, and the $Sb^{125} - Te^{125}$ decay process where more precise data were obtained than hitherto possible for the energy of 145, 321.3, and 463.1 keV levels. Author

N68-24088 Naval Civil Engineering Lab., Port Hueneme, Calif.
CALCULATING THE DOSE VARIATION OF FAST-NEUTRONS STREAMING THROUGH AN IRON DUCT Final Report, Jun. 1965–Aug. 1966

Yo Taik Song Mar. 1968 56 p refs
(NCEL-TR-570; AD-667224) CFSTI: $3.00

The dose variation of fast-neutrons streaming through an iron duct is computed by using the concept of the differential dose albedo. The basic concept of the differential albedo is itself studied and is used to formulate the neutron transport equation. The albedo method developed in this report and the Monte Carlo method are used to obtain numerical values of the multicollision absorbed dose in the first and second legs of an 11 x 11-inch iron duct along the centerline. Comparisons are then made between the values obtained by both methods. Results show good agreement. Author (TAB)

N68-24114# United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch.
THE GEM 4 CODE
T. C. Longworth 1968 68 p refs
(AHSB(S)-R-146) HMSO: 10s

The main differences between GEM 4 and its predecessor GEM 3, which concern the output, are described. Revised methods are used to estimate k_{eff} and the statistical analysis of results was modified. These changes resulted in an altered format for the punched output. Facilities for saving neutron coordinates on mangetic tape and for analyzing these were greatly extended. The section of the initialization between the basic input and the calculation was also revised. A number of checks are now made on the validity of the source neutron coordinates and in certain circumstances the coordinates may be changed automatically. This report describes all the changes to the output, the new magnetic tape output and analysis, changes to the initialization, new aspects of external sources and hole routines, and program features of GEM 4. The appendices contain a brief description of changes to the program SCAN, which is used with GEM 4, and a complete list of the input data for GEM 4. R.N.A.

N68-24216# American Meteorological Society, Boston, Mass.
THEORETICAL STUDY OF TRANSITIONS WITH DIFFERENT TYPES OF COUPLING USING THE NITROGEN ATOM AS AN EXAMPLE [TEORETICKESKOE IZUCHENIE PEREKHODOV PRI RAZNYKH TIPAKH SVIAZI NA PRIMERE ATOMA AZOTA]
Z. B. Rudzikas, Ia. I. Vizbaraite, and A. P. Iutsis Bedford, Mass. AFCRL Dec. 1967 7 p refs Transl. into ENGLISH from Tr. Akad. Nauk SSSR, Ser. Mater. (USSR), v. 2, no. 1, 1964 p 94–97 Presented at Acad. of Sci. Conf. on Spectry., Minisk, 5–11 Jul. 1963
(Contract AF 19(628)-3880)
(T-R-615; AD-667418)

A theoretical study is made of transitions of the type 2p(2) (3P) 3d(2S+1)Lf to 2p(2) (3P) 4fL (K) F with the application of both LSO-coupling and JOL-coupling for the configuration 2p(2)4f. TAB

N68-24219# Naval Radiological Defense Lab., San Francisco, Calif.
IDENTIFICATION OF Ag^{118} AS A PRODUCT OF U^{235} FISSION
Herbert V. Weiss, James M. Fresco, and William L. Reichert 27 Jan. 1968 19 p refs
(Contract AT(49-2)-1167)
(USNRDL-TR-68-21; AD-667232)

A search for 118Ag was carried out as part of a study on the distribution of nuclear charge in symmetric fission. A method was developed for the separation of silver from its palladium precursor and cadmium descendant, based upon the rapid reduction and retention of silver by finely divided copper. Silver was separated at various times after thermal-neutron fission of 235U. The copper powder with affixed silver was dissolved in concentrated nitric acid and radiochemically purified for the analysis of 118Cd derived from its silver precursor. The linear relationship between the logarithm of 118Cd activity and separation time led to the identification of 118Ag. The half-life of this radionuclide was determined to be 5.3 +0.9 or -0.7 sec. Author (TAB)

N68-24229# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF THE TOTAL NEUTRON CROSS SECTIONS OF In AND Sm [IZMERENIYE POLNYKH NEYTRONNYKH SECHENIY In I Sm]
R. B. Begzhanov, D. A. Gladyshev, S. V. Starodubtsev, and T. Khaydarov 9 Aug. 1967 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 4, 1964 p 32–36
(FTD-HT-23-655-67; AD-667647)

Measurements of the total cross sections for neutrons interacting with the In and Sm nuclei were carried out on a neutron spectrometer described earlier. The width of the channel was 8 microsec with a 2.23 microsec/m resolution for In and 2.5 microsec/m resolution for Sm. The In target was in the form of a 60 mg/sq cm metallic strip of natural isotopic composition and was investigated over the 0.7-14 ev range. Sm was in the form of a chemical compound with 120 mg/sq cm of natural samarium. The article contains a detailed description of the mathematical procedures used for the processing of experimental data. Author (TAB)

N68-24239# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
NON-LINEAR REPRESENTATIONS OF THE SU(2) GROUP [NELINEINYE PREDSTAVLENIYA GRUPPY SU(2)]
D. Stoyanov and Khr. Ya. Khristov 1967 30 p refs In RUSSIAN
(JINR-P2-3648)

Nonlinear representations of the SU(2) group are classified. It is shown that the number of irreducible unequivalent nonlinear representations of SU(2) is finite and any representation, the dimensionality of which is larger than 3, is reducible. Author (NSA)

N68-24286# European Atomic Energy Community, Geel (Belgium).
ANALYSIS OF MEASUREMENTS OF ELASTIC SCATTERING OF NEUTRAL PARTICLES, USING THE BLATT AND BIEDENHARN [ANALYSE DE MESURES DE DIFFUSION ELASTIQUE DE PARTICULES NEUTRES, D'APRES LA FORMULE DE BLATT ET BIEDENHARN]
M. G. Cao Mar. 1968 62 p refs In FRENCH; ENGLISH summary
(EUR-3744.F) CFSTI: HC $3.00/MF $0.65

BLATT 4 and ERRFIT are two programs written in Fortran IV for IBM 7090 and 360 digital computers. They can be used for calculating, by the least squares method, the values of the τ and g_{as} parameters, the theoretical and differential cross-section and the error therein for the elastic scattering of neutral particles, according to the Blatt and Biedenharn one level formula. Author

N68-24303# Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies.
A POSSIBLE EXPLANATION OF THE LAMBDA TO SIGMA RATIO IN THE ISOSPIN-1 S-WAVE $\bar{K}$ N REACTION IN A QUARK MODEL DESCRIPTION
F. Renard Nov. 1967 10 p refs
(LPTHE-TH-226)

A proposal is given for explaining the discrepancy between the calculation of the parameter ϵ in the quark model and its experimental value. In addition to the single quark amplitude a diquark amplitude of the backwards-scattering-type is considered; its value is determined independently from $K^- + p \rightarrow \Sigma + \pi$ cross sections; the prediction for ϵ agrees then with experiment, but is very sensitive to the low energy $\bar{K} + p$ parameters. Author (NSA)

N68-24307 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE DECAY SCHEME OF SUP 165 TM [SCHEMAT ROZPADU SUP 165 TM]
W. Kurcewicz, Z. Moroz, Z. Preibisz, and B. Schmidt Nielsen 1967 36 p refs Transl. into ENGLISH from Polish
(IBJ-835/IA/P) CFSTI: $3.00

The electron-capture decay $^{165}Tm \rightarrow {}^{165}Er$ has been investigated with the six-gap β-ray spectrometer as well as Ge(Li) and NaJ(Tl) γ-ray detectors. The single γ-ray spectrum, $e-\gamma$ and $\gamma-\gamma$ coincidence spectra have been studied. Some tentative levels were confirmed and several new established. The existence of 2 rotational bands built on the two similar complex structure states 1/2 + [660] + coll at the energies 507 keV and 745 keV, and of a band built on the 920 keV 1/2-state is suggested. At the energy 589 keV are suggested two close lying levels, one with the spin and parity 1/2 or 3/2—the other with 3/2+ being the second member of one of the above mentioned $K\pi = 1/2+$ rotational bands. The structure of the non-rotational states in ^{165}Er is discussed in terms of a model in which the interaction of quasiparticles with quadrupole and octupole phonons is considered. The energy spacing between states with a predominant single-particle character is compared with the energy spacing calculated on basis of the pairing force theory. Author

N68-24319# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANGULAR CORRELATIONS BETWEEN NEUTRAL PIONS PRODUCED IN NEGATIVE PION XE INTERACTIONS AT 9 GEV/C NEGATIVE PION INCOMING MOMENTUM [KORELACJE KATOWE NEUTRAL PIONS PRODUKOWANYCH W ZDERZENIACH NEGATIVE PION O PEDZIE 9 GEV/C, ZJADRAMI XE]
Kinga Eskreys 1968 39 p refs Transl. into ENGLISH from Polish Submitted for publication
(IBJ-822/VI/PH) CFSTI: HC $3.00/MF $0.65

The strong angular correlation between neutral pions have been found in the 9 GeV/c π^- Xe interactions observed in the xenon bubble chamber. The same kind of angular correlations have been previously reported for charged pions produced in $\bar{p}$–p and $\pi^{\pm}$–9 interactions. Author

N68-24324# Minnesota Univ., Minneapolis. Cosmic Ray Group.
THE SINGLY AND DOUBLY CHARGED PARTICLES IN THE PRIMARY COSMIC RADIATION
P. S. Freier and C. J. Waddington Jan. 1968 35 p refs
(Contract Nonr-710(60))
(CR-112; AD-667490)

The final results are presented of the observations made on electrons, protons, deuterons and helium nuclei, of the primary cosmic radiation using nuclear emulsions exposed in 1963, 1964 and 1965. Results are given for the intensities and energy spectra of each of these types of particle. Author (TAB)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-23074* Volt Technical Corp., Washington, D. C.
ON THE ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF EQUATIONS FOR STATIONARY SPHERICO-SYMMETRICAL OUTFLOW OF PLASMA FROM THE SUN
M. V. Konyukov Greenbelt, Md. NASA 6 May 1968 10 p refs Transl. into ENGLISH of the publ. "Ob Asimptoticheskom Povedenii Resheniy Uravneniy Statisionarnogo Sfe Richeski Simmetrichnogo Istecheniya Plazmy Iz Solntsa" Moscow, Acad. Sci., 1967, Preprint no. 148
(Contract NAS5-12487)
(NASA-CR-94511; ST-PP-SP-10709) CFSTI: $3.00 CSCL 20I

The asymptotic behavior is found for the solution of equations of stationary spherico-symmetrical outflow of plasma from the sun, at a substantial role of viscosity and heat conductivity. The expressions obtained for the principal terms of expansion point to the existence in the hydrodynamic velocity of irregular asymptotes, which differs essentially from the principal terms of expansions found by various authors. The causes of such a discrepancy are discussed. Author

N68-23115# Wisconsin Univ., Madison. Mathematics Research Center.
SOME DIFFICULTIES IN THE THEORY OF MAGNETOGASDYNAMIC FLOWS INVOLVING UPSTREAM INFLUENCE EFFECTS
G. W. Swan Dec. 1967 11 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-765; AD-666605)

In the mathematical analysis of certain types of magnetogasdynamic flow problems in which boundaries are present it is necessary to take account of the solution of the Maxwell equations in the boundary regions. Some authors have neglected to consider this solution, and this article comments on some of the formulations which are defective in this respect. Author (TAB)

N68-23130 Pennsylvania Univ., Philadelphia.
EFFECT OF INHOMOGENEOUS ELECTRON DENSITY AND COLLISION FREQUENCY IN A CYLINDRICAL PLASMA COLUMN SURROUNDED BY A HELIX
Richard James Kalagher (Ph.D. Thesis) 1966 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-3079

A system consisting of a cylindrical plasma column surrounded by a helix is studied. Particular attention is given to the effects that radial distributions of electron density and collision frequency have on the electromagnetic wave which propagates on the helix. The problem is solved by representing the plasma as a complex frequency dependent dielectric. It was found that the phase shift curves for an inhomogeneous plasma were lower than those for a homogeneous plasma, but were qualitatively the same. The insertion loss showed a peak at a frequency equal to the plasma frequency. The magnitude of the peak was directly proportional to the collision frequency. By comparing a measured curve to the theoretical curves, therefore, the system can be used for plasma diagnostics. The results of the research have shown that plasma inhomogeneities do not qualitatively affect the wave on the helix. On the other hand, the plasma-helix system has proven useful as a plasma diagnostic tool. Dissert. Abstr.

N68-23131 Connecticut Univ., Storrs.
PROPAGATION OF ELECTROSTATIC DISTURBANCES IN FINITE-TEMPERATURE PLASMAS
Carl McAlvay Ferrar (Ph.D. Thesis) 1966 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4547

An investigation is described in which the propagation of electrostatic disturbances in finite-temperature plasmas is demonstrated experimentally. It is shown theoretically that these disturbances can be produced in a plasma by assigning a small alternating velocity to the plasma boundary. Based on this result, experimental techniques are developed for production and measurement of the disturbances in argon plasmas with plasma

frequencies of order 10^7 to 10^8 radians per second and Debye lengths ranging from one to several millimeters. The experimentally determined propagation characteristics of the disturbances are found to be in good agreement with theoretical predictions. Dissert. Abstr.

N68-23146 Stanford Univ., Calif.
TURBULENCE SUPPRESSION IN MAGNETOHYDRODYNAMIC FLOWS
John George Olin (Ph.D. Thesis) 1966 169 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-4414

The effect of the suppression of turbulent fluctuations in turbulent magnetohydrodynamic flows was investigated experimentally and theoretically. The experimental work consisted of the measurement of the change in velocity profiles in a quasi-fully developed channel flow due to an imposed, transverse magnetic field of B_0 = 26.5 kilogauss. The velocity profiles were measured in a plane perpendicular to the imposed magnetic field with a special cooled Pitot tube. The electrically insulated channel had a 25-inch-long entry length and a 2-inch-square cross section. The working fluid was a hot (2600°K) combustion gas formed by burning a potassium-seeded (2 per cent by weight) ethanol–oxygen–nitrogen mixture. The Reynolds numbers of the flow were R_m = 4661, 9890, and 18930, and the corresponding Hartmann numbers were M_m = 26.3, 42.2, and 48.1 (both R_m and M_m based on mixed-mean properties and on the hydraulic diameter of the channel). The experimental results showed qualitatively that the magnetic field tended to "laminarize" the velocity profiles and to reduce, or damp, the Reynolds' stress. Dissert. Abstr.

N68-23149# Brussels Univ. (Belgium). Faculte des Sciences.
SPECTROGRAPHIC DETERMINATION OF THE DENSITY AND ELECTRONIC TEMPERATURE OF A HYDROGEN PLASMA [DETERMINATION SPECTROSCOPIQUE DE LA DENSITE ET DE LA TEMPERATURE ELECTRONIQUES D'UN PLASMA D'HYDROGENE]
R. Van Hauwermeiren (Ph.D. Thesis) 1967 222 p refs In FRENCH
(NP-17214)

A technique for the measurement of the electron density and temperature that is simple and systematic so that the magnitudes can be determined on a single phenomenon and which makes it possible to follow their evolution during the course of time was developed. A detailed investigation was then made of the phenomena absent in the density and temperature region considered. The spectroscopic methods used for the determination of the density and temperature are described and a new method for the density determination was developed. The design and construction of apparatus for this method is described. The results show that the method of determining the electron density by the ratio of the intensity of a H_2 line measured with two lengths of different slope gives reproducible results of ±15%. This determination is in good agreement with the measurements of the electron density derived from the evaluation of the half length of the ray profile given point by point. Experimental results show that the temperature measured by the method of three channels is valid in the case where the impurities have little effect on the spectra in the regions studied. Measurements on impurity lines lead to the assumption that their density can be very strong and that the atoms should play a nonnegligible role in the dynamics of the phenomena. NSA

N68-23191*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MHD BOUNDARY LAYERS INVOLVING NON-EQUILIBRIUM IONIZATION Summary Report, for Period Ending 24 Jan. 1968
A. Sherman 24 Feb. 1968 124 p refs
(Contract NASw-1586)
(NASA-CR-94537) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The boundary layer in a plasma in which the electron and heavy particle temperatures may be different was studied. The problem is formulated from the viewpoint of multi-fluid magnetohydrodynamics (MHD). It differs from earlier treatments in that the complete electron energy equation is retained so that one must consider the plasma sheath in order to establish a boundary condition at the wall on the electron temperature. Initially a two-dimensional, laminar, steady flow is assumed. Also assumed are infinitely fast ionization and recombination rates so that the electron density can be calculated from the Saha equation at the electron temperature. Actual calculations were carried out along a channel wall partly insulator and partly thermionically emitting electrode. For the initial studies, restricted to a non-emitting insulator, the method of local similarity was used to solve the equations. All later studies used a finite difference scheme and the exact equations. The results demonstrate that the electron temperature can differ significantly from the heavy particle temperature and is very dependent on the magnetic field, thermionic emission, and current level. Author

N68-23205 Northwestern Univ., Evanston, Ill.
THEORETICAL ASPECTS OF BLUNT BODY MAGNETOAERODYNAMICS
Robert William Porter (Ph.D. Thesis) 1966 222 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-4260

Theoretical aspects of supersonic magnetoaerodynamic flow about a blunt body with self contained magnetic field source are presented. The effect was studied for a hemisphere nose containing a dipole field source with body and magnetic axis at zero angle-of-attack. Theoretical predictions of the alteration of magnetoaerodynamic coefficients and of the flow field are presented for a range of parameters appropriate for possible application to planetary entry flight control and laboratory simulation. Emphasis was on determining the principal contributing effects for continuum, aerodynamic-like flows. Dissert. Abstr.

N68-23215 California Univ., Berkeley.
A NONLINEAR COMPUTER MODEL FOR LOW BETA PLASMA INTERCHANGE INSTABILITIES
Jack Austin Byers (Ph.D. Thesis) 1966 175 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-5015

A two dimensional, two fluid computer model capable of following the interchange modes of a low beta plasma well into nonlinear regimes has been developed. Low beta plasma interchange is taken to mean cooperative charged particle motion perpendicular to an externally imposed magnetic field, $\vec{B}$, which is uniform in space and constant in time. A gravitational field, $\vec{g}$, ($\vec{g} \perp \vec{B}$) is imposed to simpulate effects of $\vec{B}$ field curvature. The motion of charged particles is described entirely by guiding center equations. Finite gyro orbit effects are included as correction factors. The two dimensional motion for an ion fluid and an electron fluid is carried forward in time by a finite difference solution in both space and time of the equations of continuity. The computer model has proved successful in dealing with the nonlinear large amplitude behavior for several examples of low beta plasma interchange modes. Dissert. Abstr.

N68-23236# Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.
MEASUREMENT OF THE REFRACTIVE INDEX IN AN ARGON PLASMA AT 6328 Å AND 1.15 μ
W. F. Hug, R. S. Tankin, and A. B. Cambel Wright-Patterson AFB, Ohio ARL Dec. 1967 42 p refs
(Contract AF 33(615)-1160)
(ARL-67-0218; AD-666665)

A survey of the literature related to man-computer interaction reveals the many aspects of this problem, which appears to be in the crossroads among such diverse fields as computer languages.

computer systems operational characteristics, control theory, decision theory, information theory, applied psychology, computer display and interface engineering, etc. In this paper we have chosen to present the on-line interaction from an information and decision point of view. A model is given of the case in which a human operator is engaged on-line in the solution of a problem like debugging a program, testing a model in a scientific application, or performing a library search. In this model the human operator is considered to seek to minimize overall cost. This cost is obtained by adding the operational cost of both man and computer to a remnant terminal cost originated by the remaining uncertainty. This analysis, performed for each of a set of possible alternatives for action, may lead to select and execute one of them, to terminate the process, or to re-evaluate the possible alternatives and/or hypotheses in a search for new ones. Some practical applications in terms of response time and other characteristics of a computer utility are presented, as well as some theoretical implications from an informational point of view. Author (TAB)

N68-23286# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.

STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS Final Scientific Report, 30 Nov. 1964–30 Nov. 1967

H. J. Oskam Bedford, Mass. AFCRL Jan. 1968 23 p refs

(Contract AF 19(628)-4794)

(AFCRL-68-0272; AD-666946)

Results obtained from studying the mobility of ions and the properties of decaying plasmas are summarized. The measuring method consisted of the simultaneous application of pulse techniques and mass and light spectrometer techniques. The plasmas studied were produced in helium, neon, nitrogen, helium-neon mixtures, and helium-nitrogen mixtures. Long existing discrepancies in the explanation of the origin of the afterglow light emission were resolved in helium and neon. Information about electron-ion recombination processes was obtained. The same was possible with respect to the mobility of positive ions in their parent gas. The studies performed on nitrogen afterglows resulted in establishing the production of N2(+) ions by mutual collisions between metastable molecules. A theory and method for determining the catalytic efficiency of a surface for recombination of nitrogen atoms were developed. Author (TAB)

N68-23284# United Aircraft Corp., East Hartford, Conn. Research Labs.

PRODUCTION OF PLASMAS FOR THERMONUCLEAR RESEARCH BY LASER BEAM IRRADIATION OF SOLID PARTICLES Semiannual Report, 1 Aug. 1967–31 Jan. 1968

Alan F. Haught, Donald H. Polk, and Walter J. Fader 31 Jan. 1968 22 p refs

(Contract AT(30-1)-3578)

(NYO-3578-8; UARL-F-920365-8) CFSTI: HC $3.00/MF $0.65

The plasmas in these experiments are produced by focused laser beam irradiation of a single micron-sized solid particle of lithium hydride which is electrically suspended in vacuum at the focus of a lens. Using this technique, free-expansion plasmas have been produced which measurements show to be essentially spherically symmetric, with a total ion charge corresponding to at least single ionization of all the atoms present in the initial solid particle, and with an average plasma energy in excess of 200 eV. Theoretical studies, suing both detailed hydrodynamic calculations and a simplified integrated similarity model, of the free plasma formation and development, have been carried out. The plasma energies calculated with both models are in good agreement with the experimental measurements. The integrated similarity model has been used for calculation of the plasma energy over a wide range of the experimental parameters (particle size, focal spot size, laser power, and laser pulse duration) to determine the optimum conditions for maximum plasma energy. Theoretical studies of the early plasma-magnetic field interaction show that the initial plasma formation and development is unaffected by the presence of magnetic fields of $\leq$10 kG field intensity. As a result, the plasmas generated in the plasma-magnetic field interaction investigations are identical with those studied in the free-expansion experiments. Experimental studies of the interaction of these initially spherical, expanding plasmas with magnetic confinement fields of mirror and minimum-B geometry at field strengths up to 8 kG show that the plasma is contained at densities $\geq 10^{13}$ cm^{-3} for as long as 10 μsec (minimum-B), and that the major plasma loss is through the mirror loss cones. From measurements of the ion energy of the plasma escaping at late times, the trapped plasma in these experiments is the thermalized laser-produced plasma.

Author (NSA)

N68-23324 Northwestern Univ., Evanston, Ill.

THE LINEARIZED MAGNETOHYDRODYNAMIC FLOW PAST A SEMI-INFINITE FLAT PLATE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD

David Lawrence Hector (Ph.D. Thesis) 1966 118 p

Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4231

The steady flow of an electrically conducting fluid past a semi-infinite flat plate in the presence of a transversely applied magnetic field is considered. By linearizing the basic equations of the flow and applying Fourier transforms, the solution of the problem is reduced to solving a single Wiener–Hopf type of equation. This is done in an approximate manner and the resulting flow fields for various values of fluid conductivity are then derived and discussed. Dissert. Abstr.

N68-23373# Akademiya Nauk SSSR, Novosibirsk. Inst. Yadernoi Fiziki.

PULSED THERMONUCLEAR SYSTEM WITH DENSE PLASMA [IMPUL'SNAYA TERMOYADERNAYA SISTEMA S PLOTNOI PLAZMOI]

S. G. Alikhanov, G. N. Kichigin, and I. K. Konkashbaev 1967 13 p refs In RUSSIAN

(IIF-LA-4)

The closed system, favorable for the adiabatic compression of dense plasma by means of the deformation of the container is examined. It is shown that, during a requisite time, the system attains equilibrium and magnetohydrodynamic stability. An adequate compression rate and a short operating time makes it possible to neglect the comparatively slow loss of plasma as a result of diffusion. Author (NSA)

N68-23462 Missouri Univ., Columbia.

CONDUCTIVITY OF A PARTIALLY IONIZED PLASMA IN THE LONG WAVELENGTH LIMIT

Glenn Russell Joyce (Ph.D. Thesis) 1966 100 p

Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-912

The conductivity of a partially ionized, homogeneous plasma near equilibrium is calculated. Interactions between charged particles are treated by B.B.G.K.Y. methods and interactions between neutral and charged particles are treated by a Boltzmann collision integral. An integral equation for pair correlations between charged particles is set up and solved in terms of one particle distribution functions. In the high frequency limit, an explicit evaluation of the conductivity is obtained. Numerical calculations are made in the limit of infinite ion mass. The results are studied in terms of a charged particle-charged particle collision frequency. Dissert. Abstr.

N68-23500*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

FLUID MECHANICS OF MAGNETICALLY BALANCED ARCS IN CROSS FLOWS Semiannual Progress Report, 1 Sep. 1967–29 Feb. 1968

S. W. Bowen Mar. 1968 41 p refs

(Grant NGR-23-005-128; ORA Proj. 07912)

(NASA-CR-94576; Rept.-07912-4-P) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experimental results on steady magnetically balanced arcs in supersonic external flows are presented and are analyzed, along with investigations elsewhere in subsonic flows, to determine the important similarity parameters. The studies indicate that the steady arc has a central core, impervious to the external flow, within which differential Lorentz forces generate a circulation analogous to that generated by gravity forces in a nonuniformly heated gas in a horizontal tube. The conservation equations indicate that a Lorentz convection parameter, analogous to the Grashof number in free convection phenomena, is an important similarity parameter over a significant range of arc variables. A characteristic velocity for the core circulation is indicated. The similarity parameters that provide the interpolation between the properties of subsonic and supersonic balanced arecs indicate approximations inherent in the conservation equations to provide a valid first order solution for the internal circulation. Author

N68-23501 Florida Univ., Gainesville.
A RELAXATION THEORY OF SPECTRAL LINE BROADENING IN PLASMAS
Earl William Smith (Ph.D. Thesis) 1966 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-366

This theory makes use of the Liouville operator formalism and projection operator techniques developed by Zwanzig. The relaxation theory for line broadening in plasmas is based on a theory of pressure broadening in neutral gases developed by Fano. The primary broadening mechanism considered is the Stark interaction between a radiating atom and the electric microfield produced by the ions and electrons in the surrounding plasma. The relaxation theory uses a many-particle dilute gas treatment of the electron–atom interations. It is found that the distant electron–atom interactions neglected by the impact theories, provide an important contribution to the observed power spectrum. Dissert. Abstr.

N68-23502*# Stanford Univ., Calif. Inst. for Plasma Research.
ALOUETTE PLASMA RESONANCE PHENOMENA
J. A. Tataronis and F. W. Crawford Mar. 1968 36 p refs Presented at NATO Advan. Study Inst. on Plasma Waves in Space and in the Lab., Roeros, Norway, Apr. 1968
(Grant NGR-05-020-077)
(NASA-CR-94548; SU-IPR-234) CFSTI: HC $3.00/MF $0.65 CSCL 20I

It has been established theoretically that a magnetoplasma is capable of ringing at harmonics of the electron gyrofrequency and at the upper hybrid frequency. This resonance phenomenon arises theoretically from singularities of the plasma Green's function due to the pinching of the real wave-number axis by zeros of the dispersion relation describing the normal plasma modes. Typically, there are three values of the waver-number, $k_\perp$, where pinching occurs: first, at $k_\perp = 0$, second at $k_\perp = \pm\infty$, and third at special values where $0 < k_\perp < \infty$. The last type of ringing does not appear to have been observed either in the ionosphere or in the laboratory. In this paper, a numerical study is made of the three cases to determine the relative strengths of the corresponding ionospheric resonances, and hence to determine which resonances are to be expected in sounder experiments. Author

N68-23572*# Space Sciences, Inc., Waltham, Mass.
THE STUDY OF PLASMA-BOUNDARY INTERACTIONS Quarterly Report, 1 Sep.–30 Nov. 1967
S. Aisenberg, P. Hu, V. Rohatgi, and S. Ziering 30 Nov. 1967 29 p refs
(Contract NASw-1703)
(NASA-CR-94579; SSI-455-QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experiments have been designed to measure the electrode drag forces in pulsed plasma accelerators and to extend the previous electrode drag measurements to higher arc currents (up to a thousand amperes). The Doppler shift technique has been developed to determine the particle speed in the accelerated plasmas. A small wavelength shift of the order of 0.001 Å due to the motion of the radiating particle will be measured with an electrically modulated Fabry–Perot interferometer. To further understand the measured threshold in the electrode drag force, a physical model of threshold in momentum accommodation coefficient, depending on the melting point of surface atoms, has been developed. Author

N68-23582# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF NITROGEN RADIATION IN THE NONEQUILIBRIUM DOMAIN BEHIND A SHOCK FRONT
G. D. Smekhov and S. A. Losev 1968 7 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 7, no. 4, 1967 p 589–593
(P8-177580T)

In solving a number of problems of hypersonic, high-altitude aerodynamics it is necessary to know the radiation characteristics of the gas behind the shock in the absence of statistical equilibrium. A theoretical computation of the gas flow in the nonequilibrium domain behind the shock front is made difficult by the necessity to take account a large quantity of reactions going on in the gas at temperatures more than 6000–8000 degrees, and by the inadequate knowledge of the values of the rate constants of many processes. The shock tube is a convenient instrument for investigation of such flows. Author (P8)

N68-23593 Minnesota Univ., Minneapolis.
SIMULTANEOUS STUDIES OF MOLECULAR IONS AND MOLECULAR LIGHT EMISSION IN THE AFTERGLOW OF RARE GASES
Gerald Francis Sauter (Ph.D. Thesis) 1966 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-877

The studies presented here have dealt with the technique for simultaneously measuring the time dependence of the number density of ions present in a decaying plasma as well as the time dependence of the molecular and atomic light emission from the same plasma. The plasma was produced in pure helium and in helium in which a small amount of neon was present. One of the major results of the present investigation has been to demonstrate that the mass spectrometric method of probing a plasma is indeed a useful, a sensitive, and a reliable method of studying decaying plasmas produced in helium and helium-neon mixtures. The credibility of this method has been shown by comparing data obtained using this technique with the results of previous investigators. Specifically, the ambipolar diffusion coefficient of He^+_2 in pure helium was measured for pressures from 1 to 21 Torr and compared with similar results obtained using entirely different methods. The value was found to be constant for pressures greater than about 3 Torr, and the numerical value was in excellent agreement with previous work. Dissert. Abstr.

N68-23719# National Aeronautical Lab., Bangalore (India).
DESIGN CHARACTERISTICS OF AN ELECTROSTATIC LANGMUIR PROBE FOR NITROGEN PLASMA
M. Kalyanam and T. K. Bose Apr. 1967 41 p refs
(NAL-TN-5) CFSTI: HC $3.00/MF $0.65

The current-voltage characteristic curve for the Langmuir probe was completed for a real gas nitrogen plasma. Preliminary calculations were made to determine the Debye shielding length and different mean free paths for nitrogen plasma. Depending on the values of these quantities, the Child–Langmuir law and the diffusion theory were applied to determine the characteristic curve at different voltage ranges, where one or the other theory is only applicable. Specification of the proposed probe for fabrication is discussed. Author

N68-23781# Naval Research Lab., Washington, D. C.
MEASUREMENT AND IDENTIFICATION OF LABORATORY PRODUCED VACUUM ULTRAVIOLET SPECTRAL LINES Final Report

Nancy V. Roth (Georgetown Univ.) and R. C. Elton 16 Feb. 1968 41 p refs
(NRL-6638; AD-667584)

Spectral lines of carbon, nitrogen, oxygen, and silicon have been measured and identified on spectrograms obtained from a large theta-pinch plasma device. The first spectrogram, a time-integrated exposure at grazing incidence, covered the region from 15 to 210A. Wavelengths of approximately 350 spectral lines were determined with a maximum error of 0.008A between 15A and 130A and with a maximum error of 0.015A for the remainder of the spectrogram (due to a lack of suitable standard lines). The region from 350A to 1800A was photographed in two sections: 350A to 1050A, and 950A to 1800A. Approximately 100 lines were measured and identified. The wavelengths for the grazing incidence spectrogram were calculated by means of a computer program, written in Fortran IV, which is given together with a detailed explanation of its use. Author (TAB)

N68-23798# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research.
INVESTIGATIONS OF GAS-CONDITIONS IN THE OPERATION OF A COAXIAL PLASMA INJECTOR
Zbigniew Kozlowski and Marek Sadowski 1967 35 p refs
(INR-P-861/XVIII/PP)

An analysis was made of the composition of residual gas in the experimental chamber under stationary conditions. Examined also are variations in gas composition and partial pressures following the operation of a fast gas valve, as such are due to the discharge process in the plasma injector. It is established that the basic sources of plasma impurities are the processes of gas desorption from the walls of the experimental chamber, as well as the decomposition of heavy particles of oil vapors penetrating from the vacuum pumps. The propagation velocities of the working-gas puff admitted into the injector and the pressure–time characteristics are also determined. It is further established that, during the plasma generating discharge, there occurs a sorption activation of walls and an exchange of gases between the plasma and a fraction of the internal surfaces of the system. Author (NSA)

N68-23809# Chalmers Univ. of Technology, Goteborg (Sweden).
LARGE SIGNAL ANALYTICAL THEORY OF KLYSTRON WAVES
Sven Wallander 15 Sep. 1967 45 p refs
(Contract AF 61(052)-890)
(RADC-TR-68-137; RR-77; TN-2; AD-667562)

An analytical, nonlinear space charge wave theory is given for the velocity modulated, confined electron beam of finite radial extension. The present theory gives a more accurate nonlinear description of the electron velocities and the ac current amplitudes at the fundamental and harmonic frequencies than earlier space charge wave type theories do. Although the theory is not strictly valid after electron overtaking has occurred, a formulation is used which allows the electron velocities to be multi-valued functions of the space coordinates. Therefore reasonably good results should be expected also in the overtaking range. For very large signals the results transform to those of Websters ballistic theory. The analytical results obtained agree well with computer experiments. Author (TAB)

N68-23813# Weapons Research Establishment, Salisbury (Australia).
SPACE CHARGE OSCILLATIONS IN THE CYLINDRICAL MAGNETRON
E. H. Hirsch Dec. 1967 20 p refs
(WRE-CPD-140)

It is found that in a smooth-anode cylindrical magnetron, oscillations due to slipping stream interactions have frequencies which are linearly proportional to the magnetic field strength and are independent of the anode voltage. An earlier theory predicting a different field and voltage dependence is shown to be incorrect. For thin cathodes and low emission current the frequencies are integral multiples of the cyclotron frequency. This is confirmed by experiments, which also indicate that the oscillations cause the flow of anomalous anode current. Author

N68-23845# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC MOMENT OF PLASMA PINCH TRAVELING IN A UNIFORM LONGITUDINAL MAGNETIC FIELD
N. A. Khizhnyak 30 Jun. 1967 35 p refs Transl. into ENGLISH from Dokl. Acad. Nauk SSSR, Ser. Fiz. Tekhn. Inst. (USSR), no. 73, 1964 p 1–18
(FTD-MT-24-106-67; AD-667847)

The magnetic moment of a plasmoid is investigated theoretically. Computation of the magnetic moment of a charged particle entering longitudinally an axially symmetric magnetic field leads to an expression for the particle velocity which depends on the form of the field. Further extension of the results shows that particles with finite radius undergo velocity dispersion dependent on their radius. These results are applied to the problem of plasmoid motion using, additionally, a system of magnetohydrodynamic equations. The problem is restricted to consideration of plasma with infinite conductivity. The magnetic properties of low and high density plasmoids are shown to differ considerably. Only low temperature plasmas are considered. The influence of thermal motion and the effect of collisons on the plasmoid behavior is discussed also and the resulting modifications are presented. The equations describing the behavior of the plasmoid form a closed set and are suitable for machine computation. Author (TAB)

N68-23851# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
THE DENSITY DISTRIBUTION OF A CYLINDRICAL PLASMA
Chao-Hung Ma and Curtis C. Johnson Oct. 1967 167 p refs
(Grant NSF GK-29)
(UTEC-MD-68-028; NSF-14)

The theory of ambipolar diffusion for a d-c discharge plasma in a nonuniform magnetic field is carried out, based on the assumption that the distribution function of the ions and electrons satisfies the collisionless Boltzmann equation. The theoretical plasma density profiles predict a plasma density peak in the increasing magnetic field region. A static theory of density and potential distribution in a cylindrical electron-beam-generated plasma with zero magnetic field is developed. Electron and ion density profiles are obtained. A theory of ambipolar diffusion for a cylindrical beam-generated plasma in a uniform magnetic field is derived. The relations between plasma density and the beam and the gas parameters are obtained and density profiles are predicted. Both microwave cavity and double probe measurements are conducted. Author

N68-23869# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research.
EXPERIMENTAL STUDIES OF A COAXIAL PLASMA INJECTOR. 1. STUDY OF OPERATIONAL CONDITIONS
Merek Sadowski and Elzbieta Skladnik-Sadowska 1967 23 p refs
(INR-P-850/XVIII/PP)

Investigations were made on the optimization of the parameters and operational conditions of a coaxial plasma injector. A detailed description of the experimental system is given, and the results of measurements performed by means of magnetic probes and a high-speed camera are discussed. The velocities of plasmoids emitted are determined and the regime of efficient operation of the injector is established. Author (NSA)

N68-23870# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research.
EXPERIMENTAL STUDIES OF A COAXIAL PLASMA INJECTOR. 2. PROBE MEASUREMENTS OF ELECTRON TEMPERATURE
Marek Sadowski and Elzbieta Skladnik-Sadowska 1967 19 p refs
(INR-P-851/XVIII/PP)

In order to determine the conductivity and electron temperature of plasma generated by the coaxial injector, a detailed analysis of diamagnetic signals from plasmoids injected into a uniform magnetic field was performed. For purposes of comparison, a number of measurements were made by means of a double Langmuir probe for the case without the external magnetic field, and in the space beyond the diagnostic field. Author (NSA)

N68-23903# California Univ., Los Angeles. Plasma Physics Group.
LOW β PLASMA PENETRATION ACROSS A MAGNETIC FIELD
Burton D. Fried and Sidney Ossakow (Lockheed Missiles and Space Co., Palo Alto, Calif.) Mar. 1968 17 p refs
(Contract Nonr-4756(01))
(R-27; AD-667740)

Self-consistent solutions for the problem of a collisionless plasma streaming across a magnetic field whose dimensions are small compared to (r sub ce r sub ci) to the 1/2 power show that the electrons can accompany the ions across the field (over distances large compared to r sub ce) provided omega sub ce < alpha omega sub pe, where alpha < or = 1 is a function of the electron distribution function (alpha = 1 when the electron thermal velocities are neglected). This appears to explain the threshold, omega sub ce approx. = 0.9 omega sub pe, observed in recent experiments on plasma penetration across a radial magnetic field. Author (TAB)

N68-23913# California Univ., Berkeley.
BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. 31 Dec. 1967 46 p refs
(NP-17283)

A listing of 181 papers on high-temperature chemistry and physics of gases and plasmas is presented. NSA

N68-23989*# Illinois Univ., Urbana. Gaseous Electronics Lab.
BASIC PROCESSES OCCURRING IN GASEOUS PLASMAS IN VARIOUS CHARGE DENSITY AND ENERGY STATES Final Report
Ladislas Goldstein [1967] 23 p refs
(Grant NGR-14-005-037)
(NASA-CR-72406) CFSTI: HC $3.00/MF $0.65 CSCL 20I

This report reviews the work performed, suggests how the results of these studies can be applied to future projects and lists the technical reports, theses and scientific articles in which the results of these investigations have been published. Author

N68-23990*# Nevada Univ., Reno. Dept. of Physics.
THE MODES OF INTERNAL MAGNETO-GRAVITY WAVES
F. Winterberg and Alden McLellan, IV Oct. 1967 77 p refs
Its Preprint No. 46
(Grant NGR-29-001-016)
(NASA-CR-94616) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Small amplitude low frequency waves are treated in a plasma of infinite conductivity in the presence of magnetic and gravitational fields. In general, there are three kinds of wave motion: namely, acoustic, gravity, and hydromagnetic. In this analysis, three wave modes were found which we called the +mode, −mode, and the Alfven mode. Each mode is strongly coupled to each of the three kinds of motions, with the exception of the Alfven mode. The Alfven mode is independent of compressibility and gravity, since it can be separated from the dispersion relation. The local dispersion relation is derived and expressed in a nondimensional form independent of the constants describing a particular atmosphere. This dispersion relation is shown to exhibit the behavior of stable and unstable modes of wave propagation, which are displayed on a number of graphs and in tabular form. Author

N68-24016# Columbia Univ., New York. Plasma Lab.
EXPERIMENTAL INVESTIGATION OF PLASMA MICROINSTABILITIES IN CROSSED MAGNETIC AND AC ELECTRIC FIELDS
Alexandros J. Anastassiades Dec. 1967 147 p refs *Its* Plasma Lab. Rept. No. 38
(Contract AF 19(628)-5832; Grant NSF GK-1391X)
(AFCRL-68-0044; SR-4; AD-667548)

An anisotropic electron velocity distribution was produced in a magnetized plasma by means of an intense AC electric field near the cyclotron resonance. Unstable electrostatic waves associated with such a distribution were investigated theoretically and confirmed experimentally using the combination scattering technique. In particular, waves near the second harmonic of the electron motion imposed by the AC field were studied in detail. Their dependence on the plasma density was measured and very good agreement with the theory was obtained. Experimental observations showed that the waves were stimulated by the external AC power at least in low plasma densities. At higher plasma densities there was evidence of self-excitation. The growth rates were measured. Cyclotron harmonic electrostatic waves associated with the Maxwellian distribution, (in the absence of the AC field), were observed by means of the same technique. They were excited near the second harmonic by an extraordinary electromagnetic wave which was weakly coupled to the plasma and therefore did not perturb the thermal distribution. Qualitative agreement with the theory and other related experiments was obtained in this case. Author (TAB)

N68-24032 General Electric Co., Philadelphia, Pa. Missiles and Space Div.
EFFECT OF MOLECULAR CONTAMINANTS ON RF-INDUCED PLASMA SHIELD PROPAGATION Final Report, 15 Oct. 1964–15 Oct. 1967
G. W. Bethke 9 Jan. 1968 55 p refs
(Contract AF 19(628)-4382)
(AFCRL-68-0028; AD-667525)

It was observed that microwave irradiation of localized weak ionization in heavy rare gases (Xe, Kr, and Ar) and in molecular gases (air, N2, O2, NO, CO2, and SF6) can cause an ionization wave to form and propagate towards the rf source. This ionization wave is preceded by an electron precursor, with the electron density at the ionization wave front increasing very rapidly to a maximum followed by a relatively slow plasma decay. At rf power levels well below normal breakdown the ionization wave will form and then propagate at velocities from about 2000 to about 10 to the 7th power cm/second. In rare gases, discontinuous changes of ionization wave velocities with changes in rf power and gas pressure indicate the existence of three different velocity-controlling mechanisms in the rare gas pressure and rf power ranges investigated. These multiple mechanisms for ionization wave formation and propagation in rare gases are discussed. None of the molecular gas ionization waves studied showed such evidence for velocity-controlling multiple mechanisms. Author (TAB)

N68-24046# Cornell Univ., Ithaca, N. Y.
ON THE STRUCTURE OF IONIZATION FRONTS
R. S. B. Ong and D. L. Turcotte [1968] 6 p ref
(Contract AF 49(638)-1346; Grant AF-AFOSR-825-67)
(AFOSR-68-0749; AD-667700)

A new approach to the theory of ionization fronts is proposed. The basic mechanism is that the front propagates due to ionizing collisions between electron and neutrals. As a first analysis of the

problem, it is assumed that the temperatures are constant and T sub e >> T sub i nearly = T sub g. For small values of the amount of electrical interaction, it is found that waves may propagate at any speed greater than the electron sound speed. Author (TAB)

N68-24047# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
EFFECT OF HIGH CONDUCTIVITY ON TWO-DIMENSIONAL PLASMA FLOW Interim Scientific Report
Helmut Falser 10 Feb. 1968 26 p refs
(Contract F61052-67-C-0014)
(AFOSR-68-0740; SR-54; AD-667814)

An investigation was made of the diffusion of the inner magnetic field in a streaming plasma due to the transition from infinite to high but finite electrical conductivity was carried out. Starting from the basic configuration of the so-called aligned-field flow, it is first mentioned that under special, quite general conditions a formal reduction to normal gasdynamics can be achieved through a transformation of the dependent variables. Next, it is pointed out, that a similar reduction does not apply for the case of finite conductivity, for the original orientation between v and B is destroyed by the dissipative effect. A linearization process for the basic equations is now derived in the form of an expansion to negative powers of the magnetic Reynolds number. The resultant linear system to first order is now reduced into just one differential equation of second order, for which a method of solution is constructed by means of integral transformation techniques. Special cases are discussed. This method of solution is generally applicable for a very large number of basic flows, meaning the unperturbed configuration, following the representation of aligned field. Solutions in closed form may be achieved which may be an advantage for basic understanding of the resultant effects. Author (TAB)

N68-24048# Ohio State Univ. Research Foundation, Columbus.
PLASMA DIAGNOSTIC TECHNIQUES AND GENERATION USE IN FLIGHT CONTROL DIVISION'S PLASMA FACILITY Final Technical Report, 1 Apr. 1966–30 Aug. 1967
Marion L. Pool Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Feb. 1968 97 p refs
(Contract AF 33(615)-3672)
(AFFDL-TR-68-21; AD-667271)

A magnetic bottle and its associated two-phase 4-MHz oscillator were moved into a new building. Many details of the plasma producing device were improved. The construction and development of a static discharge system, an arc discharge assembly, and a P.I.G. facility were carried out. Diagnostic plasma measurements were made with microwave horns, Langmuir probes and Fabry-Perot interferometers. Determinations have been made on the electron number densities under different controlled conditions at various locations in the plasma. Additional tools, such as the Brush cathode and the conductivity probe, are under construction. Author (TAB)

N68-24125 California Univ., Los Angeles. Plasma Physics Group.
ANNUAL STATUS REPORT, FEBRUARY 1, 1967–JANUARY 31, 1968
Alfredo Banos, Jr., Burton D. Fried, and Charles F. Kennel Mar. 1968 15 p refs
(Contract Nonr-4756(01))
(R-28; AD-667248)

Contents: Nonlinear wave phenomena: Ion acoustic waves and Vlasov echoes; Mode coupling of drift waves; A closed form for the hot plasma dielectric tensor in a magnetic field; Two pole approximation for the plasma dispersion function; High beta plasma waves; Ion-acoustic wave effects on tunneling; Nonlinear stabilization. TAB

N68-24161*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TABLES OF Fe I LINE INTENSITIES. VOLUME 1: TEMPERATURES FROM 1000° TO 6500°K. VOLUME 2: TEMPERATURES BETWEEN 6500° AND 20,000°K
William J. Borucki Washington 1968 219 p refs
(NASA-SP-3041) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Tables of intensities for the 2200 atomic lines listed by Corliss and Warner and Corliss and Bozman for Fe I are presented for temperatures between 1000° and 20,000°K. These tables should be useful in computing the absolute intensity and the spectral distribution for Fe I line radiation from optically thin media, determining the temperature of an observed plasma, and indicating the existence of a non-Boltzmann distribution of excited electronic states when such a condition exists. Author

N68-24170# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
MICROWAVE MEASUREMENTS ON LASER PRODUCED BLAST WAVES
Richard B. Hall Mar. 1968 52 p refs
(D1-82-0688)

A microwave system for measuring the time and spatial development of a plasma ball that remains after the laser is off uses the perturbation effect of a spherical conductor on the resonant frequency of microwave cavities to obtain the plasma properties of the laser produced blast waves. Upon firing the laser, the resonant frequency of a cavity is changed by an amount proportional to plasma volume. Thus, plasma shape or volume are determined by detuning the microwave cavity through a small perfectly conducting sphere that changes the microwave cavity resonant frequency in an amount porportional to its volume. A self-tuning oscillator measures the plasma volume as a function of time. Differences between measured plasma expansion rates and predicted values from blast wave theory are attributed the reduced effective plasma radius and large electrical conductivity as the temperature increases within the traveling blast wave. G.G.

N68-24188# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe.
SOME INVESTIGATIONS ON END-EFFECTS ON THE LINEAR MFD-GENERATOR [UNTERSUCHUNGEN UEBER DIE ENDEFFEKTE AM INDUKTIVEN MFD-WANDLER]
Walter Peschka and Franz Engeln Mar. 1968 64 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-10; DVL-696) CFSTI: HC $3.00/MF $0.65

In inductive MFD-systems special problems occur where the flow enters or leaves the magnetic field. These problems are generally described as end effects. Large gradients of the magnetic field are present at the ends of a MFD-induction machine, these generating an electric current density distribution in the fluid which may spoil the performance characteristics of the generator. The two-dimensional induction MFD-generator of finite length, using a polyphase winding system to obtain a travelling magnetic field, is treated as a boundary value problem by two-sided Laplace-transform, and numerical results are given. Author

N68-24201# TRW Systems Group, Redondo Beach, Calif.
STUDY OF PROPERTIES OF ACCELERATED PLASMA Final Report
C. L. Dailey Jan. 1968 40 p refs
(Contract AF 49(638)-1210)
(AFOSR-68-0320; AD-667207)

An experimental investigation of the physical properties of the plasma produced in the discharge of an inductive, impulsive, plasma accelerator has been conducted. The objectives of the work were to continually improve the performance of the accelerator as well as to understand the plasma processes and the acceleration mechanism within the current layer. By decreasing the parasitic

inductance of the accelerator and the resistance of the spark gap during its ignition transient, it has been possible to develop a diamagnetic, snow-plow discharge in argon at 1-torr pressure on the first half-cycle without using preionization. From the interpretation of probe data, it is found that the current layer is composite having a region of electron current at the front followed by ion current deeper within the layer. The electron current ionizes the gas and supports the steep portion of the moving magnetic field front. Author (TAB)

N68-24251# Boeing Scientific Research Labs., Seattle, Wash.
PLASMA PHYSICS LABORATORY REVIEW, 1967
1967 37 p refs

Plasma production, density, and lifetime were studied, as were microwave radiation, collision-induced instability theory, and magnetoconductance. Optical line radiation was found from a gaseous plasma, modulated at twice the electron frequency, during periods when two stream instability was produced within the plasma; and an infrared laser probe was developed for a tiny semiconductor inside a dewar. A laser seismograph is in operation, a quantum mechanical number generator was tested, and the analogy between atomic bomb bursts and plasma bursts produced by a very high powered Q-switched laser was investigated. Other efforts of the plasma physics laboratory were concerned with plasmon radiation from thin metal foils, fusion power and hypervelocity impact, the quasilinear theory of Alfven waves, and hydromagnetic surface waves. The Boltzmann equation was studied with arbitrary strength electric fields, as were optical radio frequency interactions, electrical conduction in liquids, and high frequency field penetration. M.W.R.

N68-24289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STABILITY AND EVOLUTION OF MAGNETOHYDRODYNAMICS [OB USTOYCHIVOSTI I EVOLYUTSIONNOSTI UDARNYKH VOLN V MAGNITNOY GIDRODINAMIKE]
V. I. Karpman 18 Aug. 1967 14 p refs Transl. into ENGLISH from Tr. Akad. Nauk Lat. SSR, Inst. Fiz. (USSR), v. 4, 1964 p 15–22
(FTD-MT-24-182-67; AD-667850)

Shock waves in a rarified plasma within a very strong magnetic field (coinciding with the wave front plane) are discussed. Here one can neglect all dissipative effects with the exception of Joule heating caused by electron-ion collisions. In the case of low effective electron-ion collision frequencies the shock wave front has an oscillatory structure. The paper discusses: (1) the high collision frequency case when one can apply the evolutionary conditions of ordinary magnetohydrodynamics; and (2) the case when, within a sufficiently rarified plasma, there exist weakly damped perturbations with frequencies comparable to the ionic Larmor frequency omega sub H. In this last case, the analysis must take into account dispersion effects near omega sub H. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-23046# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
RARE EARTH INFRARED LIFETIMES AND EXCITON MIGRATION RATES IN TRICHLORIDE CRYSTALS
William B. Gandrud Jan. 1968 141 p refs
(Contract DA-31-124-ARO(D)-339)
(AROD-54009.P; TR-1; AD-666791)

Lifetimes of trivalent rare earth ion levels below 14,000/cm were measured in the LaCl3, GdCl3, and YCl3 hosts, using the Infrared Quantum Counter and infrared fluorescence techniques. Because of their low radiative and multiphonon relaxation rates, these levels are well suited to concentration-quenching studies. Temperature dependences provide evidence that the ion pair decays of four levels in Pr(3+) and Nd(3+) occur resonantly (i.e., without phonon assistance) between excited Stark components. This enables the measured decay rates for these four levels to be used in estimating the rate for a single resonant transfer of all of the ions energy to a neighboring ion. This latter process is the basic step of the excitation migration process. From the lifetimes of a number of levels which are quenched by migration of the excitation to sinks, an estimate of 400,000 is obtained for the number of transfers that occur before a sink is reached. Levels quenched by migration to sinks are found to decay exponentially, with a lifetime which increases with increasing crystal purity. The roles of the various relaxation processes in determining the performance of the Infrared Quantum Counter as an infrared detector are discussed. Author (TAB)

N68-23059# Cornell Univ., Ithaca, N. Y. Materials Science Center.
ACOUSTIC ATTENUATION IN KCl AND KCl:Li ION IN THE KILOMEGACYCLE RANGE
Raymond Ping Auyang (Ph.D. Thesis) Jan. 1968 72 p refs
Sponsored in part by ARPA and IBM
(Contract AT(30-1)-2471)
(NYO-2471-31; Rept.-841) CFSTI: HC $3.00/MF $0.65

The ultrasonic attenuation was measured in the frequency range of 500 to 1745 Mc at temperatures from 1.7° to 30°K. All the attenuation constants of the pure modes in KCl were found to vary as T^4 except the (111) shear mode and the (110) shear mode with a (110) polarization. For these two shear modes, the temperature variations are slower and not expressible as a single power of the temperature. A linear frequency dependence was observed for all the longitudinal modes in KCl in agreement with the collinear interaction theories. The absolute values and variations with type of mode agree qualitatively but not quantitatively with the theoretical values. The attenuation in KCl containing Li^+ impurities can be divided into two temperature regions. In the high temperature region, the attenuation follows a T^4 temperature dependence. In the low temperature region, only the attenuation of sound waves containing a trigonal acoustic mode varies with temperature. Author (NSA)

N68-23069# Florida Univ., Gainesville.
THE ENERGY BAND STRUCTURE OF FERROMAGNETIC NICKEL
John William Domville Connolly (Ph.D. Thesis) 1966 111 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-3467

The one-electron energies of electrons in a crystal of ferromagnetic nickel have been calculated within the framework of the unrestricted Hartree–Fock method using the assumption of a localized exchange potential. The solution to the equations has been effected through the augmented plane wave method, and self-consistency achieved after several iterations of this method. Two separate calculations using slightly different exchange approximations were carried out, which are shown to give qualitatively different results. In particular, the averaged free-electron exchange approximation, $V_x = -6(6\rho/8\pi)^{1/3}$ which has been used in many other energy band calculations is shown to give results in disagreement with experiment in this case. Dissert. Abstr.

N68-23091 Florida Univ., Gainesville.
ANALYSIS OF CRYSTAL GROWTH OF HIGH TEMPERATURE MATERIALS IN A PLASMA FURNACE
William Austin Smith (Ph.D. Thesis) 1966 153 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-3511

Reported is an analysis of the crystal growth mechanism of refractory materials taking place in the fireball of a plasma-heated Verneuil-type furnace. The fireball temperature is estimated at well over 9,000 K. Such parameters as the powder feed rate, thermal gradient at the liquid–solid interface, rf power level, powder grain size, geometry of the boule tip with respect to the powder probe and fireball, powder–gas flow rate and the presence of diatomic gas are investigated and their effects on crystal growth and quality are determined. It was found that the large radiation heat loss from the side of the boule dominates the thermal conditions during crystal growth. The importance of a diatomic gas as a means of heat transfer to the boule; and the effect of loss of heat due to the introduction of fine powder grains into the plasma is also discussed. It was further found that the parameters important to crystal quality are the ratio of the thermal gradient at the liquid–solid interface to the powder feed rate and the average temperature of the molten cap. Crystal quality was generally better at the periphery than at the core of a boule. It is concluded that the work reported on contributes to a more effective use of the plasma–Verneuil furnace in growing crystals of refractory materials. Dissert. Abstr.

N68-23103# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
ATOMIC TUNNELING IN SOLIDS
J. A. Krumhansl Jan. 1968 14 p refs
(Contract AT(30-1)-3699)
(NYO-3699-22) CFSTI: HC $3.00/MF $0.65

The motion of atoms by tunneling between two or more equivalent potential wells in a crystal is discussed. Atomic tunneling is discussed in connection with optical, thermal and inelastic effects, and the symmetry of defects. NSA

N68-23129# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.
INFRARED COATING STUDIES Quarterly Report, 15 Dec. 1967–15 Mar. 1968
R. L. Maier 15 Mar. 1968 27 p refs
(Contract DA-44-009-AMC-1707(E))
(QR-7; AD-666787)

Contents: Evaporated molybdates and tungstates for the near infrared; Co-evaporated PbMoO4-BaF2 films; Reststrahlen in sodium-potassium-niobate; ThF4 films. TAB

N68-23136# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
INVESTIGATION OF CRYSTAL IMPERFECTIONS BY MEANS OF LASER LIGHT SCATTERING
Richard C. Powell Dec. 1967 66 p refs *Its* Phys. Sci. Res. Papers, No. 351
(AFCRL-67-0648; AD-666918)

The use of light scattering as a method for studying imperfections in crystals is discussed. A unique apparatus using a laser as a light source for ultramicroscopy and angular scattering experiments is described. The results obtained utilizing this apparatus for investigations of imperfections in ruby crystals are presented and discussed. These investigations were done as a function of crystal growth direction, annealing, boule morphology, polarization, chromium concentration, gamma-irradiation, and temperature. The results of this work demonstrate the usefulness of this new equipment as a convenient, nondestructive technique for characterizing imperfections in crystals of relatively large size. They also indicate the existence of both randomly distributed scatterers and oriented scattering regions in ruby crystals and show how these scattering centers are altered by changes in the various parameters studied in this investigation. Author (TAB)

N68-23147# Oak Ridge National Lab., Tenn. Solid State Div.
EMPIRICAL RELATIONSHIPS FOR THE EMISSION ENERGIES AND LIFETIMES OF THE F CENTER
R. L. Gilbert Feb. 1968 25 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2054) CFSTI: HC $3.00/MF $0.65

Empirical relations for the emission energies, ϵ, and the lifetimes, τ, of the F center in the Na, K, Rb, and Cs halides have been established with the following forms: $\epsilon = AK^n$ and $\tau = A'K^{n'}$, where K_0 is the optical dielectric constant. The existence of two classes of radiative lifetimes is suggested. Those τ observed at liquid helium temperatures (fluorescence measurements) and those measured above liquid nitrogen temperature (photoconductivity measurements) yield separate straight lines on log–log plots of τ vs K_0. Implications of the existence of these correlations are discussed. Author (NSA)

N68-23178 Connecticut Univ., Storrs.
ELECTRICAL RESISTIVITIES AND TRANSITION TEMPERATURES OF SINGLE CRYSTALS OF PURE AND CADMIUM-DOPED TIN
James Everett Gueths (Ph.D. Thesis) 1966 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-4555

Approximately 60 cylindrically shaped single crystals of pure and cadmium-doped (<1% Cd) tin in the tetragonal phase were prepared. Electrical resistivity determinations were made at 373°, 273°, 77°, and 4.2°K as well as an investigation of the variation of the superconducting critical field parameters with impurity content. The anisotropy of the temperature dependent electrical resistivity $\rho(T)$ for pure tin was determined. The anisotropy of the residual resistivity (ρ_0) for cadmium impurity was determined at 4.2°K by two different experimental methods in different regions of impurity concentration (x). The residual resistivity for any specific crystal orientation is found to vary linearly with x ($\rho_{0\perp}/x = 1.39$ μr-cm/at%). Deviations to Matthiessen's rule are found to vary linearly ($\rho(T)_{impure} - \rho(T)_{pure} = 0.16\ \rho_{0\perp}$) with impurity concentration and appear to be temperature independent for 77°K $\leq T \leq$ 373°K. Dissert. Abstr.

N68-23227 Lehigh Univ., Bethlehem, Pa.
CHARACTERISTICS OF THE THALLOUS DIMER CENTER IN SODIUM IODIDE
George Kenneth Herb (Ph.D. Thesis) 1966 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4866

Characteristics of the thallium double center (dimer) in sodium iodide were studied at temperatures between 15 and 300°K at at concentrations of between 0.08 and 1.01 mole % Tl. A measurement of the lifetime of the dimer excited state resulted in a value of 7 nanoseconds as the upper limit. The method described to measure the decay time is applicable to other phosphors. The dimer decay time was found to be independent of temperature and thallium concentration for the ranges investigated. A measurement of the dimer orientation with polarized light gave a non-definitive result. In addition to the earlier proposed <110> orientation, the present study strongly suggests a <100> orientation. The model of the dimer absorption-emission process is shown to be one in which the absorption and emission processes are orthogonal. Dissert. Abstr.

N68-23235# Mithras, Inc., Cambridge, Mass.
INVESTIGATION OF ORDERED MAGNETIC STATES AND THEIR CORRELATIONS TO OPTICAL AND ELECTRICAL PROPERTIES OF SELECTED MATERIALS Final Report, 16 Oct. 1965–14 Aug. 1967

J. H. Terrell, A. Novenski, J. Schwartz, B. di Bartolo, K. Gooen et al
Oct. 1967 131 p refs
(Contract AF 19(628)-5721)
(MC-65-172-R-1; AFCRL-67-0593; AD-666676)

A report is given of electron spin resonance (ESR) studies of Cr(3+) in Al2O3 and Li2Ge7O15. Lineshape and linewidth measurements of ruby samples were carried out at K-band both inside and outside the microwave cavity. Mosaic, strain, and hyperfine splitting were found to contribute significantly to the lineshape. A new lineshape expression for the mosaic contribution was proposed. A method of testing the quality of large pieces of ruby, e.g., laser rods, without the need for cutting or any other destructive process was conceived under this contract. The magnetic properties of Y3Fe3.2Ga1.8O12 are reported based upon ferromagnetic resonance linewidth, anisotropy constants, and magnetization measurements. Particular attention is paid to the effect of impurities such as unordered Fe(3+) resulting from gallium substitution. Critical exponents were determined from magnetization measurements near the Curie point and are compared to Andersons results for pure YIG. Anomalies in the susceptibility tensor Xyx of the spin-flop transition in CuCl2.2H2O were studied. The effect of the sample shape is included exactly through the use of a 2 x 2 demagnetizing tensor. Asymmetries in Xyx could only be accounted for by postulating the existence of domains and/or inclusions in the sample. The polarized absorption spectrum of Cr(3+) in Li2Ge7O15 and the fluorescence lifetime in heavily doped ruby is reported. The general characteristics of the polarized spectrum of Cr(3+) in Li2Ge7O15 is presented in an energy level diagram. Uneven splittings of the R1 and R2 lines of ruby suggest the possibility of two inequivalent sites for the Cr(3+) ion. TAB

N68-23238# Cornell Univ., Ithaca, N. Y.
CALCULATION OF PHONON LIFETIMES IN SOLID ARGON
Hilary David Jones (Ph.D. Thesis) Feb. 1968 183 p refs
(Contract AT(30-1)-3699)
(NYO-3699-21) CFSTI: HC $3.00/MF $0.65

The theory is based on a first principles treatment of three phonon interactions in perturbation theory. The usual assumptions of the Debye approximation or of isotropic phonon–phonon interaction strength have not been made. Computer calculations are made. NSA

N68-23246*# General Dynamics Corp., San Diego, Calif. Special Nuclear Effects Lab.
RADIATION EFFECTS ON SILICON Summary Report, 1 Nov. 1965–20 Apr. 1967
J. A. Naber, H. Horiye, and E. G. Wikner 20 Jun. 1967 91 p refs
(Contract NAS7-289; Ga Proj. 430)
(NASA-CR-94536; GA-8016) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Research on the radiation-induced displacement effects in silicon included excess minority-carrier lifetime and electron spin resonance measurements. The displacement effects were produced by 30-MeV electrons at room temperature; both low and high resistivity (ultrapure) n- and p-type silicon were investigated. The defects in the high-purity n- and p-type silicon were near the center of the energy gap and were possibly intrinsic. The characteristics of these defects were determined by the excess minority-carrier lifetime as measured by the microwave-reflection technique. In the low-resistivity silicon, the defects in the Czochralski-grown (QC) silicon were oxygen-dependent, whereas the defects in the vacuum pulled (FZ) silicon were impurity-dependent. The defects in this low-resistivity silicon were measured by dc conductivity. ESR measurements yielded information about divacancy production, the position of the divacancy energy levels in the energy gap, and Si–G8 formation. However, complete correlation between ESR-detected centers and carrier lifetime recombination levels was not obtained. Author

N68-23272 Northwestern Univ., Evanston, Ill.
A STUDY OF THE DEFECT STRUCTURE OF LEAD SULFIDE
Kenneth Raymond Zanio (Ph.D. Thesis) 1966 118 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4284

The simultaneous diffusion of Pb^{210} and Bi^{210} into undoped single crystals of lead sulfide and single crystals doped with 4×10^{18} and 4×10^{19} bismuth atoms per cm^3 has been studied as a function of deviations from stoichiometry at 700°C. It was found that the ratio of tracer diffusion coefficients, $D_{Pb}210/D_{Bi}210$, is equal to one and is independent of deviations from stoichiometry for undoped lead sulfide single crystals and crystals doped with 4×10^{18} and 4×10^{19} bismuth atoms. The addition of 4×10^{18} atoms of bismuth to lead sulfide does not increase the diffusion coefficients of Pb^{210} and Bi^{210} for $-6.7<\log p_{S_2}<0.0$ at 700°C. For $\log p_{S_2} > -3.9$ and at 700°C the single ionized cation vacancy is the predominant defect through which Pb^{210} and Bi^{210} diffuse and the majority atomic defect in lead sulfide. The addition of 4×10^{19} atoms of bismuth increases the self-diffusion coefficients of Pb^{210} and Bi^{210} for $-6.7 < 10g\ p_{S_2} < 0$ at 700°C. Diffusion coefficients for undoped lead sulfide at 700°C between the present and previous authors are in good agreement for $0.0 > \log p_{S_2} > -2.0$ and agree within an order of magnitude for $-2.0 > \log P_{S_2} > -8.0$. Dissert. Abstr.

N68-23306# Army Electronics Labs., Fort Monmouth, N. J.
ELECTRONIC COMPONENT OF THE THERMAL CONDUCTIVITY IN SEMICONDUCTORS
Irving N. Greenberg Feb. 1968 44 p refs
(ECOM-2932; AD-666760)

The report is a sequel to AD-651 229, dated February 1967, here we discuss considerations peculiar to semiconductors and semimetals, such as the influence of carrier concentration and degeneracy on the thermal conductivity and the Wiedemann–Franz–Lorenz law. The electronic component of thermal conductivity for an intrinsic semiconductor is discussed in terms of both electrons and holes. Following from this, the transport properties of an intrinsic semiconductor and is discussed in terms of both electrons and holes. Following from this, the transport properties of an intrinsic semiconductor and the thermal resistance in semiconductors arising from free electrons are discussed in the light of previously developed theory. Author (TAB)

N68-23384 Texas A&M Univ., College Station.
A STUDY OF SPIN WAVES IN ALKALI HALIDES
Edward John Sharp (Ph.D. Thesis) 1966 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4722

Using a torque magnetometer, the magnetic properties of high purity, optical quality, single crystals of sodium chloride, potassium chloride, magnesium fluoride and calcium fluoride have been investigated. The observed torque arises from the interaction between the applied magnetic field and two magnetic moments ... a permanent moment which is independent of the measuring field and an induced moment that is proportional to the field. In addition to this induced magnetization, there is also a co-operative interaction among the magnetic centers which give rise to an observed permanent moment. Measurements on the MgF_2 and CaF_2 samples support the idea that it is indeed the magnetic centers along dislocations in the crystals that give rise to the observed magnetic effects; for these crystals have very few dislocations, and a decrease of the magnetization was observed in these crystals when compared to the magnetization observed in the alkali halides. Dissert. Abstr.

N68-23417 California Univ., Los Angeles.
THE INFLUENCE OF HYDROSTATIC PRESSURE UPON THE MAGNETIC TRANSITIONS IN GADOLINIUM-DYSPROSIUM ALLOYS
Frederick Milstein (Ph.D. Thesis) 1966 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4481

The magnetic phase transitions in the Gd-Dy binary alloy system were experimentally investigated, and the effect of pressure upon the magnetic transitions of selected alloys was determined. The measurements are performed by correlating the magnetic phase transitions with the secondary voltage of a small toroidal transformer, the core of which is the Gd-Dy alloy itself. As the sample transforms from a non-ferromagnetic to a ferromagnetic state, a large increase in permeability and hence in secondary voltage is observed. A transition from a paramagnetic state to a state in which the elementary magnetic moments are aligned in an oscillatory, non-ferromagnetic manner is indicated by a sharp peak or cusp in the secondary voltage curve. Dissert. Abstr.

N68-23426 Michigan Univ., Ann Arbor.
THE ELECTRON PARAMAGNETIC RESONANCE SPECTRUM AND RELATED OPTICAL PROPERTIES OF TRIVALENT IRON IN CUBIC AND AXIAL FIELDS IN ZINC SELENIDE
Gordon Glenn Wepfer (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-1823

The purpose of this study is to investigate the electron paramagnetic resonance (EPR) spectrum of specific zinc selenide crystals. The optical and electrical properties are also characterized in order to relate the defects responsible for the optical and electrical behavior and those responsible for the EPR observations. This leads to a model for the nature of the imperfection levels observed in these crystals. Cubic zinc selenide crystals were grown by vapor phase deposition and were purposely doped with lithium using LiOH in the charge. The EPR spectrum at 77°K consists of an intense line at $g = 2.0464 \pm 0.0004$ and a group of angular dependent lines each of which varies between $g = 2.072 \pm 0.004$ and $g = 6.1 \pm 0.1$. The intense line is attributed to the central $(1/2 \rightarrow -1/2)$ transition of Fe^{3+} in a zinc substitutional site. The other fine structure lines are resolved in some crystals. Dissert. Abstr.

N68-23433# New York Univ., N. Y. Radiation and Solid State Lab.
MECHANISMS OF ENERGY TRANSFER IN DIELECTRICS Semiannual Report, 1 Apr.–30 Sep. 1967
Werner Brandt Feb. 1968 14 p ref Sponsored in part by DASA (Contract DA-28-043-AMC-01999(E))
(SAR-3; ECOM-01999-3; Rept.-3; AD-666775)

The processes pertinent to the moderation of electrons of energies near the internal ionization energy of a dielectric are studied. The probe for these studies is the positron through its annihilation characteristics. The decay characteristics are related to the cross sections of electronic scattering and energy loss. Author (TAB)

N68-23464*# Rensselaer Polytechnic Inst., Troy, N. Y. Div. of Nuclear Engineering and Science.
RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH ENERGY ELECTRONS Final Progress Report, 15 Mar. 1967–15 Mar. 1968
John C. Corelli 15 Mar. 1968 26 p refs
(Grants NsG-290; NGR-33-018-090)
(NASA-CR-66619) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Stress induced dichroism studies of divalency associated energy levels in irradiated silicon were conducted. A brief review of the experiments and the results obtained is included. An abstract is given of a paper dealing with the effects of 50 MeV electrons on the ultimate Fermi level in p-type germanium doped with gallium and indium and n-type germanium doped with antimony and arsenic. The ultimate Fermi level was found to be positioned closer to the valence band as a result of irradiation by particles capable of imparting a larger maximum recoil energy to the germanium atom. Infrared absorption studies of 45 to 50 MeV electron irradiated heavily doped silicon were discontinued because of program termination. The research was to determine the impurity associated radiation induced defects by infrared spectroscopy measurements on silicon samples doped to relatively high concentrations with Bi, As, BO, and P. R.N.A.

N68-23484 Minnesota Univ., Minneapolis.
EXTRACTION AND INJECTION OF HOT ELECTRONS IN THIN FILM EMISSION DIODES
Eugene Diedrich Savoye (Ph.D. Thesis) 1966 209 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-28

Studies involving injection, transmission, and energy losses of hot electrons in Al–Al_2O_3 thin film emission diodes, with Al and Au as overlayer material, were carried out. Procedures were developed which allowed various detailed experiments to be carried out with a given thin-film sample, utilizing a specialized high-vacuum tube structure designed and constructed for this purpose. The main emphasis in the experimental work was on studies of Al-Al_2O_3-Au thin film emission diodes; data obtained from similar samples with Al and with composite Al-Au overlayer films yielded valuable additional information. A difference in work function between Au and Al of 0.8 eV was measured using a low energy electron gun, and a voltage difference of similar magnitude was seen in the I-V characteristics for Au as compared with Al overlayer samples. Dissert. Abstr.

N68-23490 Minnesota Univ., Minneapolis.
EFFECT OF LOCAL ATOMIC ORDER ON ELECTRICAL AND MAGNETIC PROPERTIES OF AU–FE ALLOYS
Robert Charles Sundahl, Jr. (Ph.D. Thesis) 1966 200 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-884

Measurements have been made of local atomic order, magnetic properties and electrical resistivity on a series of Au–Fe alloys. The alloys were Au-rich metastable solid solutions with up to 39.5% Fe. Measurements were made on alloys in two states: quenched from 900°C, and quenched and subsequently aged one week at 75°C. X-ray diffuse scattering measurements established that the alloys were nearly random. Indications are that a small amount of clustering prevails in the quenched alloys. Aging seems to increase the amount of clustering. A model of the magnetic structure of this alloy system is proposed, based upon these experiments and previous Mössbauer and magnetic measurements. It is suggested that the experimental results can be explained by the presence of two types of interactions; short nearest-neighbor interactions which predominant in concentrated alloys and weak long-range interactions which predominant in dilute alloys. Dissert. Abstr.

N68-23506 Louisiana State Univ., Baton Rouge.
THE MAGNETOACOUSTIC EFFECT IN THALLIUM
Julian Barham Coon (Ph.D. Thesis) 1966 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-1154

Geometric resonances in 99.9999% purity thallium metal have been observed with longitudinal sound waves propagated along the three major axes at frequencies up to 162 Mc. The calipers of both sections of the third band hole surface and those assigned to the fourth band electron surfaces are in general agreement with the band calculation of Sovan, even though some data associated with the fourth band appears to agree well with the nearly-free electron theory. Evidence of open orbits in the [10T0] direction has been seen which is in agreement with the predicted degeneracy of the third and fourth bands along AL. No open orbits were seen in the [0001] direction, establishing further evidence for the non-connectivity of the fourth band electron surface in the c-direction. The theory of Pippard for the absorption of energy from a sound wave due to interactions with electrons in metals is discussed and expanded in the appendices. Dissert. Abstr.

N68-23522 North Carolina Univ., Chapel Hill.
A STUDY OF SOME PROPERTIES OF ELECTRICAL CONDUCTION IN NICKEL–IRON THIN FILMS
Frederick Charles Williams, Jr. (Ph.D. Thesis) 1966 65 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-1066

An attempt is made to gain some information pertaining to the nature of ferromagnetic thin films. Previous research on resistivity and magnetoresistance is discussed as well as some of the theoretical background of this work. The equipment used is explained in detail, and the limitations of the experiment discussed. A small anisotropy in the resistivity of these films has been found, indicating that the structure of the film is somewhat anisotropic. The resistivity has been found to be strongly dependent on the method of evaporation since the fast evaporation used in this experiment produced resistivity values much higher, and a value for the mean free path of the electrons much lower than the corresponding values for more slowly evaporated films. The magnetoresistance has also been found to be strongly dependent on the evaporation technique, having a different and quite unexpected dependence on thickness, compared to previous results. Finally, the temperature dependence of magnetoresistance above room temperature has been investigated for various thicknesses of films and shown to have at most a slight dependence on thickness.
Dissert. Abstr.

N68-23529 North Carolina Univ., Chapel Hill.
SPIN WAVE RESONANCE IN THIN PERMALLOY FILMS PREPARED IN ULTRA-HIGH VACUUM
Glenn Irven Lykken (Ph.D. Thesis) 1966 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-1022

The subject of ferromagnetic resonance is introduced and the dispersion relation for spin waves in thin films is developed. The dependence of the absorption spectrum on the spin pinning is shown. The method of attaining ultra-high vacuum and producing films in this vacuum is described along with a procedure for making resonance measurements on films in vacuum before exposure to the air. The effects on the resonance absorption spectra of thin films produced by aging in vacuum and in air, by annealing and by various substrates are discussed. Dissert. Abstr.

N68-23557# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
THE NONLINEAR MICROWAVE EFFECTS IN SUPERCONDUCTING FILMS
Su-Min Chou and Curtis C. Johnson Jan. 1968 123 p refs
(Grant NSF GK-717)
(UTEC-MD-68-029; NSF-15)

The basic wave propagation problem in a rectangular wave guide with a thin conducting film placed across it has been solved. The microwave transmission and reflection are simple functions of film resistance and frequency. The experimental measurements and theoretical prediction give reasonable agreement. As the thin film is in a superconducting state, the conductivity of the film is a function of the applied magnetic field. A Taylor's series expansion for conductivity σ involving the derivatives of σ with respect to the magnetic field H has been used to study the microwave nonlinear effects, especially for the harmonic generation. A rather complicated wave equation has been solved with the help of simplifying approximations to find the possible generated modes and power of harmonic signal. These calculations show that for a very thin film (less than one hundred angstroms) the generated harmonic signals in both the transmitted and the reflected wave are equal. Pure tin was used for such experimental investigation at 9.075 GHz. The results are in close qualitative correspondence to the theoretical predictions, and a basic understanding of the nonlinear electrodynamics which will lead to the further study of microwave nonlinear effects of superconductors has been obtained. Author

N68-23558# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
LOCALISED ELECTRONIC CONDUCTION BEHAVIOUR OF ANODIC OXIDE FILMS ON ZIRCONIUM
N. Ramasubramanian Mar. 1968 35 p refs
(AECL-3082) CFSTI: HC $3.00/MF $0.65

The light sensitive and semiconducting properties of cuprous iodide are used in a new technique for studying the electronic conduction behaviour of anodic oxide films on zirconium. This technique provides information both on the distribution and nature of the conduction sites and has several advantages over existing methods. Specimens biased to either positive or negative potentials can be investigated; the resolution is better than or equal to that of the other methods; less damage is done to the sample during the testing and there is only a slight increase in the over-voltage for the reaction with increase in oxide thickness. The last property makes the cuprous iodide imaging technique essentially different from the other methods. The conduction sites have been identified with the impurity particles present in the starting material. Anodic oxidation results in a thin insulating oxide film on these particles and their conductivity is determined by the contact used. Author

N68-23588 Minnesota Univ., Minneapolis.
THE INFLUENCE OF SODIUM OVERLAYERS ON THE WORK FUNCTION OF GERMANIUM
Linus Francis Cordes (Ph.D. Thesis) 1966 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-8

An experiment is described in which the dependence of the work function of cleaned Ge surfaces on Na overlayer coverage was studied. All the results were obtained from near intrinsic single crystals and measurements were made on the 111 crystal face. The surfaces were cleaned by the argon ion bombardment technique and then annealed at 500°C to restore surface order. Na was deposited in either of two ways. The first method employed the use of conventional evaporation and collimation techniques to form an atomic beam of Na. The second involved the use of a Na aluminosilicate ion emitter and electrostatic focusing system to form a beam of Na ions. Overlayer coverages were determined by measuring the ion current to the sample. Work function changes were measured by the retarding potential difference method, and checked in some instances by the Kelvin method. When plotted on semilog paper, the work function vs. coverage curve consisted of four straight line segments separated by distinct breaks. The effect of heating the partially covered surface was also investigated.
Dissert. Abstr.

N68-23600 North Carolina Univ., Chapel Hill.
POSITRON ANNIHILATION IN SOLID AND LIQUID METALS AND SEMICONDUCTORS
John Henry Kusmiss (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-1013

The angular correlation of the photon pairs emitted when positrons annihilate in solid and liquid Al, Sb, Bi, Cd, Ga, In, K, Pb, Li, Hg, Se, Te, Tl, Sn, and Zn has been measured. Experiments were performed for each material at room temperature and at temperatures just above and below the melting point. Experiments have also been performed on Mg and Ge at room temperature and at another temperature higher than room temperature but still below the melting point. In addition the metals Ba, Ca, and Sr have been studied at room temperature with better counting statistics and the metal Y with better angular resolution than has previously been reported. Results are presented in the form of experimentally determined angular correlation curves and also in the form of slope distributions derived from the angular correlation data.
Dissert. Abstr.

N68-23621 New York Univ., N. Y.
ELECTRONIC STRUCTURE OF LUMINESCENT CENTERS IN 2–6 COMPOUNDS
Wolfgang Walter (Ph.D. Thesis) 1966 132 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-642

Energy levels and wave functions of luminescent centers formed by Ib impurity ions substituting for the cation in some II–VI compounds have been calculated. The centers considered are those formed by Cu, Ag, and Au in ZnS, ZnO, ZnSe, and ZnTe and CdS. We have, in particular, concentrated on the ZnS:Cu center. This work is an outgrowth of the model proposed by Birman to explain optical transitions in ZnS:Cu. Our calculations are based on semiempirical LCAO molecular orbital theory. We isolate a cluster of ions consisting of the impurity ion and its first and second neighbors. In order to estimate the positions of the localized levels with respect to the valence and conduction bands, calculations were carried out for a cluster with the normal host ion at the center. The energy levels resulting from such a calculation formed two groups corresponding to the valence and conduction levels. These were then compared to the impurity cluster calculations. The results of these calculations were consistent with Birman's model.
Dissert. Abstr.

N68-23624 New York Univ., N. Y.
PHOTOVOLTAIC EFFECT IN CdS CRYSTALS
Julius Shain (Ph.D. Thesis) 1966 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-632

In CdS crystals and evaporated layers, various types of photovoltages are observed: (1) a Dember voltage due to excitation by nonuniformly absorbed radiation; (2) a Becquerel voltage due to chemical reaction of excited CdS with solutions; and (3) a p–n junction type of photovoltage occurring at interfaces (e.g., Cu_2O–CdS). To discriminate between these types of voltages, various electrodes (electrolytes of $CdCl_2$ and insulating mylar barriers coated with Al) were used under various conditions of irradiation. The rectifying properties and the photovoltaic characteristics of the arrangements associated with these voltages were investigated. It was found that, in high dark resistance photoconductive CdS crystals, the photovoltage is predominantly due to the Dember effect, even with liquid electrodes.
Dissert. Abstr.

N68-23627 Yale Univ., New Haven, Conn.
MOLECULAR SEMICONDUCTORS UNDER HIGH PRESSURES
Robert Stanley Kirk (Ph.D. Thesis) 1966 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-99

Bridgman anvils have been adapted for high impedance measurements at high pressures by the use of epoxide adhesive rings. The electrical properties of copper phthalocyanine were studied over a pressure range extending to 60 kbars. Discontinuities of the energy gap, thermoelectric power and resistance indicate the presence of two new phases at high pressure. Results are analyzed in terms of an energy band model with deep lying impurity levels. Electrical measurements were also made on quinhydrone and DPPH at high pressures. The Bridgman anvils were then adapted for Hall effect and magnetoresistance measurements. The magneto galvanic measurements were made on samples of bismuth, tellurium and selenium. Experimental results show that both bismuth and tellurium transform to more metallic phases at pressures of 24 and 43 kbars, respectively. Above 30 kbar selenium transforms to another semiconducting phase with low carrier mobility and state density.
Dissert. Abstr.

N68-23670# General Electric Co., Schenectady, N. Y. Research and Development Center.
GRUENEISEN NUMBERS FOR MOLECULAR SOLIDS
R. E. Baker, Jr. Jun. 1967 11 p refs
(Rept.-67-C-238)

A phenomenological theory is developed which expresses the Gruneisen parameter directly in terms of experimentally determined anharmonic coefficients. Based on this theory, a molecular model of solid state, long chain polymer molecules is formulated to relate the Gruneisen parameter to an intermolecular potential function. The relationship between harmonic and anharmonic moduli is verified.
E.J.S.

N68-23674 Texas A&M Univ., College Station.
LITHIUM FLUORIDE THERMOLUMINESCENT RESPONSES TO NEUTRONS
Pao-Shan Weng (Ph.D. Thesis) 1966 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-265

Neutron-irradiated Con-Rad type N and type 7 lithium fluoride are systematically studied according to the isothermal annealing, the glow curve analysis, and to the different energies ranging from thermal to 14 MeV. Special efforts have been made to investigate the half life of isothermal decay, the kinetics, the frequency factor, the trap depth, the probability factor, and the dosimetry prospect. The details of neutron flux measurements are given since it is important to the neutron dosimetry work. The comparison of the thermoluminescent effect due to gamma-rays and neutrons is also included.
Dissert. Abstr.

N68-23700 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
TIME SPREADS OF PULSES GENERATED BY β PARTICLES IN SILICON DRIFTED DETECTORS [ROZRZUTY CZASOWE IMPULSOW GENEROWANYCH PRZEZ CZASTKI β W KRZEMOWYCH DETEKTORACH DRYFTOWYCH]
M. Moszynski, W. Kurcewicz, and W. Przyborski 1967 34 p refs Transl. into ENGLISH from Polish Presented at the Nanosecond Electron. Conf., Dubna, Jun. 1967 Submitted for publication
(IBJ-867/IA/E) CFSTI: $3.00

Results of the study of the time spreads of pulses from the silicon drifted detectors irradiated by 976 keV (Bi^{207}) beta particles at their positive electrode side are presented. A number of 0.8–2.4-mm-thick detectors was tested at the room temperature and the liquid nitrogen temperature. Two components of the time spreads have been found to exist: one of them being proportional to the detector pulse rise time and inversely proportional to the reduced average range of beta particles, and another one independent of these quantities, however, characteristic for the individual detector. Initial risetime of the pulses, up to 20% of the total amplitude, were determined. The results of studies are in disagreement with the predictions of the available approximate theory of the charge collection in the detectors.
Author

N68-23705 United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
CASCADE THEORY OF DEFECT PRODUCTION
D. Heinrich and R. Lenk Jun. 1967 21 p refs Transl. into ENGLISH from Phys. Status Solidi (Ger.), v. 3, 1963 p 676–691
(AERE-TRANS-1090) HMSO: 3s 6d

The basic assumptions of cascade theory are discussed and a very general angular dependent formulation of this theory is developed which contains apart from the threshold energy a further energy parameter. Angular integration then gives the continuous displacement probability. This general model contains as special cases most of the models discussed by other authors and therefore interpolation is possible. The general continuous displacement probability can be reduced mathematically to give a sharp threshold energy. This procedure is quite general and allows a physical interpretation. As a test case the hard core approximation for the scattering law has been applied to the present theory.
Author

N68-23711 Yale Univ., New Haven, Conn.
SPECTRAL EFFECTS RELATING TO THE ELECTRONIC STRUCTURE AND CRYSTAL INTERACTION OF PLANAR GLYOXIME COMPLEXES
Francis Kevin Krist (Ph.D. Thesis) 1966 183 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-105

The solid state spectra of a group of planar glyoxime complexes have been studied in order to resolve previous inconsistencies in these spectra and to understand the electronic structure in molecules and crystals of these complexes. Polarized crystal absorption, polarized crystal reflection, and liquid nitrogen colloid spectra were obtained. A novel and potentially useful method of preparing crystallites, finely dispersed in a transparent glass, which allows accurate comparison of solution and solid absorption spectra was developed in the colloid work. The previously reported single crystal studies were found to be highly qualitative or inaccurate and have presented an incomplete picture of the spectral alterations which occur in crystals of these complexes. Certain essential spectra were measured quantitatively—either through the Kramers–Kronig relation, which provides extinctions from the reflection spectra, or directly, through an interference determination of crystal thickness.
Dissert. Abstr.

N68-23720# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
AN ANALYSIS OF THE LIMITS OF VALIDITY OF THE METHOD OF ROBERTS AND VON HIPPEL FOR THE DETERMINATION OF THE DIELECTRIC CONSTANTS OF A SOLID IN THE REGION OF MILLIMETRE WAVES [ANALISI DEI LIMITI DI VALIDITA DEL METODA DI ROBERTS E VON HIPPEL NELLA DETERMINAZIONE DELLA COSTANTE DIELETTRICA DI UN SOLIDO, NEL CAMPO DELLE ONDE MILLIMETRICHE]
R. Lelli 27 Oct. 1967 34 p refs In ITALIAN; ENGLISH summary
(ISS-67/37) CFSTI: HC $3.00/MF $0.65

The limits of validity of the Roberts and Von Hippel method for the measurement of dielectric constants at microwave frequencies are analyzed and it is shown that it is possible to determine, by means of the Smith chart, the orders of magnitude of the errors in the measurements and the manner in which these errors are related to sample length and to frequency. Some error formulae are also given for correcting the influence of the gap on the experimental results. Finally, measurements are reported on a sample of plexiglass in the frequency range 28–40 kMc/s. Author

N68-23745 Brigham Young Univ., Provo, Utah.
MEASUREMENTS OF THE RECOILLESS FRACTION AND OTHER MOESSBAUER EFFECTS OF Fe 57 IN IRON AT HIGH PRESSURES
William Horace Southwell (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-578

The relative Mössbauer fraction f in iron metal has been measured as a function of pressure to 80 kbar in a tetrahedral anvil pressure apparatus. The initial variation is approximately four times the variation expected from the Debye theory assuming a Gruneisen constant of 1.6. Reported is the discovery of the pressure magnet effect in the iron foil sample. As the pressure on the iron sample increases, the magnetic domains align themselves and the iron becomes magnetized. At 80 kbar at least 31% of the magnetic moments are aligned perpendicular to the plane of the iron foil sample. This effect is reversible and reproducible. The 6-line Mössbauer spectra have been analyzed with a computer program which returns values for the least-square best-fit Lorentzian lines. Changes with pressure of the relative effective magnetic field, the isomer shift, and the electric field gradient have also been measured and the results are reported. Dissert. Abstr.

N68-23769# Boeing Scientific Research Labs., Seattle, Wash.
SOLID STATE PHYSICS LABORATORY REVIEW, 1967
1967 43 p refs

Laboratory activities which deal with the relationship between the physical properties of solids and their structure, particularly the mechanical properties of alloys, are summarized. These deal with stress concentration and corrosion, nucleation and precipitation, phase transformation, fracture, fatigue damage, deformation, and dislocation. Exoelectron and acoustic emission, ultrasonics, electron paramagnetic resonance, X-ray absorption spectroscopy, and X-ray astronomy studies are also reported. Scientific papers and staff activities, a cumulative bibliography of publications of the laboratory, and symposia and lectures given at the laboratory are presented.
M.W.R.

N68-23779# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
A STUDY OF THE CRITICAL POINTS OF THE BAND STRUCTURE OF GRAPHITE BY MEANS OF THERMO-MODULATED REFLECTANCE [STUDIO DEI PUNTI CRITICI DELLA STRUTTURA A BANDE DELLA GRAFITE MEDIANTE TERMO-MODULAZIONE DELLA RIFLETTIVITA]
A. Balzarotti and M. Grandolfo (Aquila Univ.) 30 Oct. 1967 38 p refs In ITALIAN; ENGLISH summary
(ISS-67/38) CFSTI: HC $3.00/MF $0.65

The differential reflectance of graphite crystals were measured in the energy range 4–6.5 eV by modulating the optical constants of the crystals with temperature. The results indicate that the strong peak around 5 eV, previously observed in absolute reflectivity measurements, is due to an M_1 saddle point singularity. In addition they show a structure at 5.96 eV, resolved for the first time, which is related to an M_0 transition occurring at the center of the Brillouin zone. Author

N68-23780# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
CORRECTIONS TO THE CASCADE THEORY OF DEFECT PRODUCTION
G. Diener, D. Heinrich, and R. Lenk Jun. 1967 14 p refs Transl. into ENGLISH from Phys. Status Solidi (Ger.), v. 3, 1963 p 2069–2082
(AERE-TRANS-1089) HMSO: 2s 6d

An approximate solution of the integral equation of cascade theory is obtained by the introduction of an equivalent collision distribution, for conditions in which the original collision distribution does not permit an exact solution. The method is applied to the collision distribution, and the influence of collision chains on the defect concentration estimated for chains in copper. This calculation shows a reduction in the defect concentration of about 7%. A discussion is given of the effect of a change in the atomic interaction potential on this correction. Author

N68-23794# General Electric Co., Schenectady, N. Y. Research and Development Center.
ELECTROLUMINESCENCE IN 2–6 COMPOUNDS
M. Aven Aug. 1967 9 p refs Presented at the Intern. Conf. on 2–6 Semiconducting Compds., Providence, 1967
(Rept.-67-C-333)

Luminescence in 2–6 compounds resulting from the application of an electric field has been observed in a great variety of different junction structures. Most of these have been heterojunctions consisting of a luminescent and an electron or hole injection component. More recently several homojunction systems have received increased attention. These have involved p-n junctions in simple and mixed crystal systems, as well as avalanche and photo p-n junction structures. In this review we will first present a short general survey of electroluminescence in 2–6 compounds, followed

by a more detailed look at the role of defect chemistry in this area of research. We will conclude with a brief forecast of the possible future developments in the defect chemistry and electroluminescence of 2–6 compounds. Author

N68-23831# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRICAL CONDUCTIVITY OF A ZINC CHARGE [ELEKTROPROVODNOST' TSINKOVOY SHIKHTY]

A. K. Pinayev, V. I. Smirnov, and Yu. A. Yablonskiy *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 123–128 refs (See N68-23814 13-15)

Additional study is devoted to the electrical properties of the zinc charge in connection with the progressive electrothermal method of obtaining zinc. The article describes the installation and procedure for determining the conductivity of briquettes of crushed zinc charge by the contact method in an atmosphere of nitrogen at 700–1400° and results of measurements are given. Author

N68-23849# ManLabs, Inc., Cambridge, Mass.

PHYSICAL CHARACTERIZATION OF ELECTRONIC MATERIALS, DEVICES AND THIN FILMS Technical Report, 1 Dec. 1966–30 Nov. 1967

Edward T. Peters Jan. 1968 37 p

(Contract F19628-67-C-0173)

(AFCRL-68-0091; SR-1; AD-667547)

In support of research being carried out by the Properties and Phenomena Branch, Solid State Science Laboratory, Air Force Cambridge Research Laboratory, a service effort is being conducted that is directed toward the characterization of specified physical, chemical and structural properties of submitted specimens. Experimental methods include chemical analysis, reflection electron diffraction, X-ray diffraction and fluorescent analysis, electron probe microanalysis and light microscopy in addition to the determination of specific properties such as density, hardness and thermal conductivity. Special services such as crystal orientation, cutting, grinding and polishing are also being performed. Specific materials submitted for characterization include single crystals of calcium tartrate, cuprous chloride, cuprous bromide, lithium germanate, sodium germanate and cobalt silicide, thin film deposits of germanium, silicon carbide and arsenic on various substrate hosts and irradiated crystals of silicon and quartz. In addition, a large variety of specimens have been submitted for specific studies, such as phase identification, crystallinity and chemical analysis. Author (TAB)

N68-23854# Stanford Univ., Calif. Solid-State Lab.

PHOTOEMISSION AND OPTICAL STUDIES OF COBALT, PALLADIUM, PLATINUM, AND GADOLINIUM

Albert Yeou-Cherng Yu May 1967 203 p refs

(Contract ARPA SD-87; Grants NSF GP-1033; NSF GK-149)

(SU-SEL-67-045; TR-5215-1; AD-667544)

Photoemission and optical reflectivity measurements on cobalt, palladium, platinum, and gadolinium have been made to determine the major features of their electronic structures. Nondirect transitions predominate the optical transitions in all of these materials; however, direct transitions (or nondirect transitions with varying matrix element) are also observed in palladium and platinum. The optical density of states of cobalt is found to be very similar to that of nickel and iron, despite the fact that all three metals have different crystal structures. They all have a strong peak at about 5 eV below the fermi level. No such peak is present in the optical densities of states of palladium and platinum at this energy, though the latter has a strong peak at about 7 eV below the fermi level. The optical density of states of palladium and platinum all have strong peaks right below the fermi level, in reasonable agreement with the findings based on specific heat and magnetic susceptibility data. The noble metals, copper, silver, and gold, also have strong peaks near the top of the d states. The optical density of states of gadolinium is found to be in reasonable agreement with the calculated density of states for -4 eV = or < E - E sub f = or < 0. TAB

N68-23860# Brown Univ., Providence, R. I.

MATERIALS SCIENCES PROGRAM Sixth Annual Technical Report, 1 Jul. 1966–30 Jun. 1967

30 Jun. 1967 145 p refs

(Contract ARPA SD-86)

(AD-660385)

Contents: Low temperature properties of materials: metals (normal and superconducting), semiconductors, insulators, helium; Properties of materials at higher temperatures: metals, semiconductors, insulators, liquid metals; Properties of surfaces and films; Inorganic chemical compounds: structure and properties; Molecular structure and intermolecular forces; Defects and dislocations; Physical metallurgy: powder metallurgy, deformation studies, calorimetry; Magnetic materials and devices; Non-crystalline solids: structure and properties; Mechanical behavior of materials; Elastic and viscoelastic behavior; Ultrasonics and acoustics; Mathematical - theoretical. TAB

N68-23864# Naval Research Lab., Washington, D. C. Lab. for the Structure of Matter.

THE TANGENT FORMULA PROGRAM FOR THE X-RAY ANALYSIS OF NONCENTROSYMMETRIC CRYSTALS

Stephen A. Brenner and Peter H. Gum 21 Mar. 1968 76 p refs

(NRL-6697; AD-667463)

The report contains a description and operating instructions for the tangent-formula refinement program applicable to noncentrosymmetric crystals. This program is coded entirely in FORTRAN language for a large-sized memory computer and is completely listed in the Appendixes. Author (TAB)

N68-23879# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.

ENHANCEMENT OF SURFACE BARRIER, DIAMAGNETISM, PARAMAGNETISM, AND CRITICAL CURRENT IN Nb_3Zr WIRES IN TRANSVERSE FIELDS BY AXIAL MAGNETIC FIELDS, AUGUST–OCTOBER 1967

M. A. R. Le Blanc Jan. 1968 19 p refs

(Contract F04695-67-C-0158)

(TR-0158(9230-01)-1; SAMSO-TR-68-134; AD-667787)

The surface barrier, the diamagnetic magnetization, the residual flux, and the critical current of Nb3Zr wires in transverse fields can all be enhanced by a factor of approx. = 3 by axial magnetic fields. It is argued that this arises because the pinning force density at the surface and in the bulk increases as B to the nth power where 0.5 n 1.0. The role of azimuthal currents and the effects on alternating-current losses are discussed. Author (TAB)

N68-23910# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

ISOTOPE EFFECTS IN THE CRYSTAL SYMMETRY AND NATURE OF THE PHASE TRANSITIONS IN $NaH_3(SeO_3)_2$ AND $NaD_3(SeO_3)_2$

R. Blinc, A. Levstik, J. Stepisnik, Z. Trontelj, and I. Zupancic Feb. 1968 6 p refs Submitted for publication

(NIJS-R-522) CFSTI: HC $3.00/MF $0.65

NMR data show that the triclinic ferroelectric phase which exists in $NaH_3(SeO_3)_2$ between −79°C and −173°C does not appear in $NaD_3(SeO_3)_2$. The transition from 2/m → 1 in $NaH_3(SeO_3)_2$ is connected with a doubling of the unit cell dimensions both along the a and b axes, whereas in the low temperatures phases of symmetry m in $NaH_3(SeO_3)_2$ and $NaD_3(SeO_3)_2$, the unit cell is doubled in the b direction only. The transitions are of the order–disorder type. Author

N68-23940# California Univ., La Jolla. Inst. for the Study of Matter.
SUPERCONDUCTING METALLURGY
B. T. Matthias *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 11 p refs (See N68-23931 13-34)

New metallurgical developments and their significance on superconducting metals as titanium, tungsten borides, molybdenum borides, uranium, and lanthanum; are discussed. S.C.W.

N68-23942# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Solid State Physics Research Lab.
LASERS FROM 2–6 COMPOUNDS
Donald C. Reynolds *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 22 p refs (See N68-23931 13-34)

Bound excitons were studied in both pure and cadmium rich crystals. The prominent bound exciton lines, I_1, I_2, and I_5 (I_{2B}) are shown, together with the Γ_5 and Γ_6 intrinsic excitons bound to neutral or ionized donors and acceptors. The most important feature noted in these spectra is that as the crystals are increasingly doped with Cd (going from (a) to (b) to (c)), the I_1 line decreases in intensity, frequently appearing as a doublet at the low Cd concentrations. Similarly, the I_2 intensity also decreases but much faster. A strong line appears at 4869 (I_5) and a weak line appears at 4895 (I_{8_2}), in the acoustical phonon wing of I_1. It is hypothesized that I_1 is associated with the broad green bands, since as I_1 decreases so do they; and when I_1 is absent so are the green bands. It was further found that as the Cd concentration increases, I_5 and I_{8_2} grow stronger, while I_1 and I_2 finally disappear completely. In extremely Cd-rich crystals (range of 10%), I_5 and I_{8_2} dominated the spectrum, with I_{8_2} becoming very intense and somewhat broadened. It is surmised that under UV excitation, the I_{8_2} laser line becomes strong and is dominant in the Cd-rich spectra. Several other sharp lines and groups of lines were observed in these spectra at relatively low Cd concentrations. S.C.W.

N68-23970# Connecticut Univ., Storrs. Dept. of Physics.
INVESTIGATIONS OF RADIATION EFFECTS IN SOLIDS BY ELECTRON SPIN RESONANCE Progress Report, 1 Feb. 1967–31 Jan. 1968
Otis R. Gilliam 31 Jan. 1968 27 p refs
(Contract AT(30-1)-2047)
(NYO-2047-42) CFSTI: HC$3.00/MF$0.65

Radiation-induced defects in nonmetallic single crystals are being investigated by electron spin resonance and by optical absorption methods. The 1-MeV electron accelerator has been used to generate hydrogen atomic displacements in ammonium bifluoride crystals. Neutral hydrogen atoms and F_2^- ions, have been studied by ESR following the irradiation at 77°K. The F_2^- ions reside in three inequivalent sites. Two of F_2^- ions are shifted in angle from the normal anion orientations, indicative of radiation-induced lattice distortion. Measured optical absorptions agree closely to the 2.1- and 4.0-eV bands reported earlier for irradiated potassium bifluoride, for which the latter band was correlated with the F_2^- ion. Similar studies are in progress on sodium bifluoride crystals. Gamma-ray or electron irradiation of potassium cyanate (KNCO) yields blue coloration and two paramagnetic species. One ESR spectrum consists of an S = 1/2 three-line hyperfine structure with an isotropic g value of 1.999, isotropic hyperfine constant of 2.3 G, and an anisotropic hyperfine constant of 2.7 G. This spectrum is attributed to a rotating CN neutral molecule restricted to rotation in the (110) and ($1\bar{1}0$) planes of the tetragonal unit cell. NSA

N68-23981# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
DISLOCATION DRAG MECHANISMS AND THEIR EFFECTS ON DISLOCATION VELOCITIES
W. P. Mason Feb. 1968 35 p refs Sponsored in part by AF and ARPA
(Contract Nonr-266(91))
(TR-58; AD-667736)

Evidence is presented that dislocations move with nearly the shear speed of sound in the twinning process in tin and zinc. Such dislocations require a high shearing stress to start but progress through the body with a shearing stress in the order of 10 to the -4th power mu where mu is the shearing modulus. With the drag coefficient of zinc, which has been measured to be 7 x 10 to the -4th power dyne sec/cm sq at low velocities, this would be impossible unless the drag decreases at high velocities. It is shown that phonon and electron drag coefficients proposed by the writer have this property since at high velocities there is not time to interchange the thermal energy with the phonons and the drag coefficient becomes very small. Author (TAB)

N68-23982# Signals Research and Development Establishment, Christchurch (England).
AN ASSESSMENT OF THE LONG TERM SEMICONDUCTOR REQUIREMENTS FOR STATIC POWER CONVERSION EQUIPMENT
C. E. Mugford May 1967 21 p
(SRDE-67006) CFSTI: HC$3.00/MF$0.65

The paper is a review of the long term semiconductor requirements for power conversion equipments. The assessment was made after a close study existing devices and techniques as used by various manufacturers and establishments, and forms a general study covering thyristors, power transistors and associated power devices. Author (ESRO)

N68-24021# Hewlett-Packard Co., Palo Alto, Calif. Solid State Lab.
STUDY OF NON-RADIATIVE RECOMBINATION PROCESSES IN SEMICONDUCTORS Final Report, 7 Jul.–30 Sep. 1967
Egon E. Loebner 28 Feb. 1968 38 p refs
(Contract N00014-67-C-0440)
(AD-667743)

Mechanisms of non-radiative recombination processes in semiconductors have been investigated. Two major areas are dealt with. The first are Auger processes; the second are multiphonon processes. Twenty different mechanisms of Auger processes are outlined and discussed. The case for multiphonon non-radiative transitions points towards multiphonons of the resonance type, known to be associated with very heavy substitutional impurities. It is shown that such phonons could and probably do contribute significantly to some non-radiative processes. Author (TAB)

N68-24036 Oregon Univ., Eugene. Dept. of Physics.
MAGNETO-OPTICAL AND RELATED STUDIES IN SIMPLE OXIDE CRYSTALS Final Scientific Report, Jan. 1, 1966–December 31, 1967
James C. Kemp 1 Mar. 1968 6 p refs
(Grant AF-AFOSR-577-66)
(AFOSR-68-0451; AD-667217)

Continued study of simple lattice defects in single-crystal IIA oxides was carried on, utilizing previous methods (ESR and optical spectroscopy) plus some new methods of magneto-optical spectroscopy. The spectral Faraday rotation associated with the main visible and u.v. absorption bands in neutron-irradiated MgO and CaO was surveyed; this enabled the characterization of the several such bands as due to either paramagnetic or diamagnetic centers. The magneto-optic nature of the F bands in MgO and CaO, at 4.9 and 3.7 e.v. respectively, showed the F centers involved to be analogous to those in alkali halides, with negative p-state spin-orbit coupling. The zero phonon line of the CaO F center was identified by the magneto-optic double resonance method. In a separate project, the charge-transfer reaction F - F was studied in CaO:Ca crystals. Author (TAB)

N68-24081# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SURFACE STRUCTURE, ELECTRICAL AND PHOTOELECTRIC PROPERTIES OF THIN LAYERS OF SULFUROUS LEAD OBTAINED BY CATHODE SPUTTERING [POVERKHNOSTNAYA STRUCTURA, ELEKTRICHESKIYE I POTOELEKTRICHESKIYE SVOYSTVA TONKIKH SLOYEV SERNISTOGO SVINTSA, POLUCHENNYKH KATODNYM RASPYLENIYEM]

R. Ya. Berlaga and M. I. Rudenok. *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 9 May 1967 p 203–205 (See N68-24058 13-06)

Thin PbS layers were produced by the cathode-sputtering method under a bell jar at 10^{-1} to 10^{-2} mm Hg pressures and at temperatures of 250°–270°C. Average evaporation rate was 0.2 μ per hour; the substrate was at a 3.5–4 cm distance from the cathode. The activation energy was calculated from temperature dependence of conductivity using both the cathode sputtering technique and evaporation in vacuum with noticeable differences in the measured conductivity between the two methods. The adsorption spectrum was measured in thin polycrystalline layers of PbS obtained by the cathode sputtering method. Electron microscopic and electron diffraction studies were carried out. The PbS layers obtained exhibit the same properties as the layers produced by the vacuum evaporation method. The ability to produce polycrystalline and single crystal PbS films is shown to be possible by the cathode-sputtering method. Author

N68-24147# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRICAL CONDUCTIVITY OF CADMIUM OXIDE IN HIGH-FREQUENCY ELECTRICAL FIELDS [ELEKTROPROVODNOST' OKISI KADMIYA V VYSOKOCHASTOTNYKH ELEKTRICHESKIKH POLAYAKH]

R. A. Baltrushaytis and P. P. Brazdzhyunas 10 Aug. 1967 12 p refs Transl. into ENGLISH from Litovsk. Fiz. Sb. (USSR), no. 4, 1964 p 537–541
(FTD-HT-23-657-67; AD-667644)

Results are given of an investigation into the electrical conductivity of polycrystalline samples of cadmium oxide using the non-electrode method in the frequency range (7 to 8.9) x 10 to the 9th power cps. Author (TAB)

N68-24160# California Univ., La Jolla. Dept. of Physics.

SPECULATIONS ABOUT GREY TIN

D. Sherrington and W. Kohn 1 Apr. 1968 17 p refs
(Contract Nonr-2216(11))
(TR-53; AD-667837)

Groves and Paul have, on the basis of experimental evidence, given strong arguments that in grey tin the valence and conduction bands touch at k = o. This suggests that at sufficiently low temperatures this phase may undergo an excitonic transition. The critical temperature may be estimated from the binding energy E sub B of an exciton: kT sub c approximately equals E sub B = (mu/m)/epsilon squared Rydbergs, where mu is an effective reduced mass and epsilon is an effective dielectric constant. From the work of Groves and Paul and of Ewald and co-workers it is possible to estimate (mu/m) at about 0.02. If one accepts the estimate epsilon = 24 given by Lindquist and Ewald one finds T sub C approximately equals 5 degrees K. From group theoretical considerations one finds that the new phase would belong to one of three space groups of lower symmetry and in one case would be weakly ferromagnetic. These conclusions are however highly tentative because of uncertainty about the dielectric constant epsilon and the suppression of the transition by small concentrations of impurities. Experimental studies of the dielectric constant epsilon(omega) would be highly desirable and interesting. Author (TAB)

N68-24186*# GCA Technology Div., GCA Corp., Bedford, Mass.

PHOTOELECTRIC YIELDS OF METALS IN THE VACUUM ULTRAVIOLET Final Report

J. A. R. Samson and R. B. Cairns Nov. 1966 61 p refs
(Contract NAS5-3918)
(NASA-CR-94614; GCA-TR-66-17-N) CFSTI: HC $3.00/MF $0.65 CSCL 20L

A study designed to measure the absolute photoelectric yield of various cathodes including W, Ni, Al, Pt, LiF, and SrF_2 from 250 to 1300 Å is reported. Also, the reproducibility of these yields were to be investigated periodically and conclusions to be drawn about their stability. The effects of irradiation by 1 MeV electrons on the yield of LiF was investigated. The photoelectric yields of three compounds, namely, CuBe, SrF_2, and LiF are tabulated. The conditions under which enhanced yields can be obtained and the stability of the yields are discussed. Author

N68-24220# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

ON THE INTERACTION BETWEEN POINT DEFECTS AND INCLUSIONS IN CRYSTALS

M. F. Ashby Jan. 1968 29 p refs
(Contract N00014-67-A-0298-0010; ARPA SD-88)
(TR-548; AD-667238)

When a crystal containing incoherent inclusions is quenched, the vacancy concentration in it can approach its new equilibrium value if vacancies enter the inclusion - matrix interface. The loss of vacancies lowers the free energy of the matrix, but it generates misfit at the inclusion which is associated with an increasing elastic strain-energy. Equilibrium is temporarily re-established when a vacancy leaving the matrix and entering the interface lowers the chemical free energy of the matrix and increases the strain energy by equal amounts. This equilibrium is temporary only, since, given time, the vacancies ultimately drain to the free surface, the vacancy concentration falls to its true equilibrium value, and the elastic strain disappears again. This report calculates the magnitude of the elastic strains which form at inclusions due to this effect. They can be large: much larger than those due to difference in coefficient of thermal expansion. If the strains are large enough, prismatic punching will occur at the inclusions to relieve them. Inclusions thus provide a mechanism for condensing vacancies into prismatic loops without the usual nucleation step. The actual number of vacancies which can be accepted by an inclusion is large, in spite of the strains which form: this means that a volume fraction of, say, 1% of inclusions can act an an efficient sink for vacancies. TAB

N68-24248# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

THE USE OF A BUBBLE MODEL TO STUDY STRESS-INDUCED MIGRATION AND SLIDING OF GRAIN BOUNDARIES

M. F. Ashby and R. Raj Mar. 1968 29 p refs
(Contract N00014-67-A-0298-0010; ARPA SD-88)
(TR-556; AD-667589)

Stress-induced grain boundary sliding and migration was studied using a bubble model. Two important results emerge which, we believe, apply to boundaries in real crystals. First, sliding occurs by the propagation of grain boundary dislocations, which may have large burgers vectors, in the plane of the boundary; the magnitude of the burgers vector, and the pre-existing density of these dislocations in the boundary depends on the boundary angle and orientation. Second, migration is very like the process of crystal growth from the vapour: atoms leave or join one side of the boundary at steps; a boundary of which one side is a close-packed plane rarely migrated. The process of sliding periodically places atoms in a position which favours their leaving one side of the boundary and joining the other; this can result in sliding and migration which are proportional, and suggests a model for thermally activated grain-boundary sliding. Author (TAB)

N68-24249# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
SECOND HARMONIC LIGHT GENERATION IN CRYSTALS WITH NATURAL OPTICAL ACTIVITY
H. J. Simon and N. Bloembergen Feb. 1968 42 p refs
(Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(TR-554; AD-667252)

Whenever a circularly polarized laser beam propagates along an axis of three-fold symmetry in a piezoelectric crystal, the second harmonic polarization is circularly polarized in the opposite sense. Rabin and Bey have discussed the theory of second harmonic generation in crystals with natural optical activity. We have observed this circular polarization and also the difference in coherence lengths for opposite senses of circular polarization, with both fundamental and second harmonic beams propagating along the (111) direction in single crystals of $NaClO_3$ and $NaBrO_3$, belonging to the cubic class 23, for which the proper eigenmodes are circularly polarized waves. The nonlinear susceptibility of both $NaClO_3$ and $NaBrO_3$ has been measured and compared with the nonlinear susceptibility of a-quartz. The relative sign of the susceptibilities has been determined in second harmonic interference experiments with the same laser beam traversing two crystals in succession. The interesting question of the sign of the nonlinear susceptibility, piezoelectric constant, optical activity, and the absolute atomic configuration of the antipodes is discussed. The question of conservation of angular momentum is resolved by taking into account the crystalline field potential of three-fold symmetry which gives rise to a torque on the crystal lattice. Author (TAB)

N68-24273*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
MANY-BODY THEORY OF A RAPIDLY VARYING INHOMOGENEOUS ELECTRON GAS
John William Gadzuk Washington May 1968 94 p refs
(NASA-TR-R-283) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The case of an inhomogeneous electron gas within which the density variation is significant over a spatial range of the order of a Fermi wavelength is considered. The first considerations are directed towards the problem of a weak periodic potential in an interacting electron gas. The momentum-dependent self-energy is calculated for an electron propagating in the many-body medium of an electron gas plus a periodic lattice pseudo-potential. This is the equivalent of a quasi-particle energy spectrum and thus an orthogonalized plane wave energy band. It does not appear that the lattice drastically changes qualitative aspects of plane wave many-body theory. A dielectric formulation for a general inhomogeneous electron gas is presented. By introducing a new image technique, the dielectric function within the random phase approximation, which is valid in the surface region of an electron gas, is obtained. A Green's function formalism is developed for treating the static dielectric screening of a point impurity in an electron gas. The surface dielectric function is used with the impurity screening formalism to treat the problem of impurity screening in the surface region. Author

N68-24284 Ohio State Univ., Columbus.
RATIONAL APPROXIMATIONS IN CRYSTAL STRUCTURE ANALYSIS
James William Boss (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-2416

A method for the calculation of those crystallographic functions usually calculated as Fourier series has been developed. For a given degree of precision, a set of coefficients f_{Hn} and g_{Hn} need be calculated only once. The subscript H is the index obtained by use of the Donnay "High Index Line Synthesis." These coefficients are then used to form an approximation to the crystallographic function, e.g., the electron density ρ. The form obtained is $\rho(xyz) = K_0 + X(K_1 + X(K_2 + ...(K_r)...)$. The variable X is a simple function of the coordinates of the usual sampling grid. The approximation is formed by the application of the method of rational approximation developed by Maehly. A Chebyshev expansion of the individual terms in the High Index Line Synthesis leads to an additive set of approximations, which may be combined to give an overall approximation. Once a set of coefficients for the usual values of hkl is prepared, an individual calculation becomes a very simple and speedy operation. Dissert. Abstr.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-23589# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SLUSH HYDROGEN PUMPING CHARACTERISTICS
D. E. Daney, P. R. Ludtke, D. B. Chelton, and C. F. Sindt 1 Apr. 1968 43 p refs
(NBS-TN-364) GPO: $0.30

The pumping characteristics of liquid-solid mixtures of parahydrogen (slush hydrogen) were investigated using a centrifugal type liquid hydrogen pump with a specific speed range of 1600 to 3100. Performance tests at 8,000, 11,000, 14,000, and 19,000 rpm and cavitation tests at 11,000 and 14,000 rpm were made. As predicted by theory, the developed head for liquid and slush hydrogen are the same when the difference in density is considered. The pump efficiency, cavitation constant and NPSH requirements for slush hydrogen are also the same as for the triple-point liquid. After 34 minutes running time with slush hydrogen out of a total running time of 79 minutes, the pump components showed no wear over that expected from operation in liquid. Author

N68-23629 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 1: THERMODYNAMIC PROPERTIES AND EQUILIBRIUM COMPOSITION: AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 154 p

Tables for air and the products of combustion with air of kerosine (C_nH_{2n}) and hydrogen fuels are presented. Système International units have been used; the pressure range is from 1 to 8×10^7 Pa, and the temperature range 100° to 6000°K. Second virial corrections are included. Author

N68-23630 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 2: THERMODYNAMIC PROPERTIES FOR FUEL-WEAK MIXTURES: C_nH_{2n}/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 205 p For abstract, see N68-23629.

N68-23631 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 3: EQUILIBRIUM COMPOSITION FOR FUEL-WEAK MIXTURES: C_nH_{2n}/AIR

B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 198 p For abstract, see N68-23629

N68-23632 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 4: EQUILIBRIUM COMPOSITION FOR FUEL-WEAK MIXTURES: C_nH_{2n}/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 197 p For abstract, see N68-23629.

N68-23633 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 5: THERMODYNAMIC PROPERTIES FOR STOICHIOMETRIC AND FUEL-RICH MIXTURES: C_nH_{2n}/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 198 p For abstract, see N68-23629.

N68-23634 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 6: EQUILIBRIUM COMPOSITION FOR STOICHIOMETRIC AND FUEL-RICH MIXTURES: C_2H_{2n}/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 198 p For abstract, see N68-23629.

N68-23635 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 7: EQUILIBRIUM COMPOSITION FOR FUEL-RICH MIXTURES: C_nH_{2n}/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 198 p For abstract, see N68-23629.

N68-23636 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 8: THERMODYNAMIC PROPERTIES FOR FUEL-WEAK MIXTURES: HYDROGEN/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 197 p For abstract, see N68-23629.

N68-23637 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 9: EQUILIBRIUM COMPOSITION FOR FUEL-WEAK MIXTURES: HYDROGEN/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 198 p For abstract, see N68-23629.

N68-23638 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 10: EQUILIBRIUM COMPOSITION FOR FUEL-WEAK MIXTURES. HYDROGEN/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 198 p For abstract, see N68-23629.

N68-23639 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 11: THERMODYNAMIC PROPERTIES FOR STOICHIOMETRIC AND FUEL-RICH MIXTURES: HYDROGEN/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 197 p For abstract, see N68-23629.

N68-23640 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 12: EQUILIBRIUM COMPOSITION FOR STOICHIOMETRIC AND FUEL-RICH MIXTURES: HYDROGEN/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 197 p For abstract, see N68-23629

N68-23641 Advisory Group for Aerospace Research and Development, Paris (France).
PROPERTIES OF AIR AND COMBUSTION PRODUCTS WITH KEROSINE AND HYDROGEN FUELS. VOLUME 13: EQUILIBRIUM COMPOSITION FOR FUEL-RICH MIXTURES: HYDROGEN/AIR
B. Banes, R. W. McIntyre, and J. A. Sims Bristol, England Bristol Siddeley Engines, Ltd. 1967 199 p For abstract, see N68-23629.

N68-23685# Oregon State Univ., Corvallis. Radiation Center.
INORGANIC FLUORIDE PROPELLANT OXIDIZERS. VOLUME 1: THEIR EFFECTS UPON SEED GERMINATION AND PLANT GROWTH Interim Report, 15 May 1964–15 May 1966
Donald J. Reed, Frank N. Dost, and Chih H. Wang Wright-Patterson AFB, Ohio AMRL Nov. 1967 218 p refs
(Contract AF 33(615)-1767)
(AMRL-TR-66-187; V. 1; AD-667556)

Certain inorganic fluorides were reviewed for their chemical, physical and toxicological properties. The compounds are nitrogen trifluoride; tetrafluorohydrazine; chlorine trifluoride; bromine pentafluoride; oxygen difluoride; hydrogen fluoride, and fluorine. Seeds and seedlings of bean, corn, pea, squash and sudan grass were exposed to air or water mixture of these compounds. Exposure of dry seeds to a gaseous 100% NF3 atmosphere for 1 to 8 hours caused inhibition of subsequent germination depending on the seed species. Exposure of seeds to a 10% N2F4 atmosphere for 1 hour completely inhibited germination of all five species of seeds. Exposure of dry seeds to less than 500 ppm of either bromine pentafluoride or chlorine trifluoride in air drastically reduced their subsequent germination even when the exposure time was for less than one hour. Exposures of plant seedlings to gaseous ClF3 in air at 500 and 2,000 ppm for 5 minutes resulted in extensive destruction of the plants; bromine pentafluoride-air mixtures were even more damaging than ClF3 atmospheres. Concentrations of N2F4 or NF3 up to 10,000 ppm in air were required to cause

visible damage of plant seedlings after a 30 to 60 minute exposure period. Plant injury was caused by irrigation of plant seedlings with solutions formed by the reaction of ClF3 or BrF5 with water. The exposed seeds and seedlings were analyzed for fluoride content. The equipment and methods used for these exposures is described. Author (TAB)

N68-23807 Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
STORAGE STABILITY OF HIGH TEMPERATURE FUELS. PART 1: MICRO FUEL COKER TESTS OF FUEL RADIOTRACER BLENDS BEFORE STORAGE Technical Report, Mar. 1967–Mar. 1968
Marvin L. Whisman and Cecil C. Ward Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. Mar. 1968 103 p refs
(Contract F33615-67-M5003)
(AFAPL-TR-68-32, Pt. 1; AD-667818)

The report describes investigation of the influence of fuel constituents during storage on thermal stability of high-temperature hydrocarbon jet fuels. The study was initiated utilizing a micro fuel coker test apparatus to measure the thermal stability of fuels and the contribution of selected fuel components, labeled with radiotracers, to deposit-forming reactions. Forty-one blends using five fuels and nine radioactive fuel components were prepared, given initial tests and stored at 130F. Aliquots of the five test fuels were depolarized by silica gel percolation and test blends were prepared from these treated fuels for comparison with untreated blends. In a third series of tests, contaminants in the form of red iron oxide and water were added to fuel-radiotracer blends. These 68 blends and approximately 44 additional samples yet to be prepared will be retested after 52 weeks of storage to determine the effect of storage upon deposit-forming tendencies of the labeled fuel compounds. Author (TAB)

N68-24152# Naval Research Lab., Washington, D. C.
FACTORS IN THE COALESCENCE OF WATER IN FUEL Interim Report
Robert N. Hazlett 13 Feb. 1968 32 p refs
(NRL-6669; AD-667715)

The removal of water from jet fuel is a necessity for the efficient operation of jet aircraft and the reduction of maintenance requirements. Experimental work was performed to examine the important factors and forces in the coalescence phenomenon by which water is normally removed from jet fuel in field operations. The basic tool used in this study was the Water Separometer. The experimental work was supported by theoretical calculations. The interception process, rather than diffusion or inertial-impaction, is the primary mode of water-droplet approach to a fiber when a water-in-fuel emulsion is coalesced in a fibrous bed. The experimental evidence for the importance of small fibers in the coalescer material is supported by calculations for the interception process. The attachment step does not appear to be critical in the overall coalescence process. Surface-active materials function at the fuel/water interface rather than the fuel/solid interface. The marked deterioration of performance caused by surfactants in the fuel is thought to be related to phenomena occurring at the point of droplet release at the downstream face of the coalescer. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-23116# Solar, San Diego, Calif.
PRELIMINARY DESIGN OF AN ADVANCED EXHAUST GAS DIVERTER Final Report
Albert Mierlot Dec. 1967 179 p
(Contract DA-44-177-AMC-433(T))
(ER-1856; USAAVLABS-TR-67-69; AD-666803)

The report contains results of a design study program for an advanced device for the diversion of high energy gas generator turbine discharge gases. Numerous concepts of such devices were initiated during the preliminary period. Evaluation of these concepts resulted in the selection of two design approaches for further design studies. One design, a basic butterfly valve, embodies significant improvements over the current type. The second design represents a unique concept which uses a rotating elbow enclosed within a housing to achieve gas flow diversion. An analysis and comparison of the two designs brought about the selection of the butterfly approach for the preparation of a final design and for the preparation of manufacturing drawings. A manufacturing plan describing the processes and methods which would be required to fabricate a prototype version of the butterfly valve is included. Author (TAB)

N68-23152# General Motors Corp., Indianapolis, Ind. Allison Div.
INVESTIGATION OF COORDINATED FREE TURBINE ENGINE CONTROL SYSTEMS FOR MULTIENGINE HELICOPTERS Final Report, 2 Dec. 1966–15 Jul. 1967
Robert M. Swick and Charles A. Skarvan Dec. 1967 159 p
(Contract DAAJ02-67-C-0009)
(EDR-5298; USAAVLABS-TR-67-73; AD-666796)

Various multiengine helicopter control concepts were analyzed and evaluated to determine an optimum system design to relieve engine monitoring during critical flight maneuvers. Power turbine governing mode evaluations showed that a proportional power turbine governor with a lagged gain reset (feedback) is desirable. Governing stability was based on a linearized representation of the engine-controls-rotor system and included both Bode diagram analysis and analog simulation. Power transient response was evaluated by using a nonlinearized digital computer simulation of the different modes and the engine and rotor system, with collective load transients imposed. The gas producer control requirements found necessary were automatic start sequencing, closed-loop steady-state turbine temperature limiting, emergency power operation capability with both manual and automatic selection, and governing action using a gas producer control fuel metering valve. Isochronous control of power turbine speed was evaluated and found to be a feasible alternative to collective pitch lever coordination of the power turbine governors. The isochronous speed control also was found to cause potentially undesirable speed excursions during collective induced power transients. The multiengine governing-load sharing concept selected utilized individual governors for each engine, with closed-loop load sharing control and an automatic engine malfunction detector. A digital computer simulation of promising control schemes and a multiengine-helicopter power system was developed and utilized in steady-state and transient analyses. Author (TAB)

N68-23181*# TRW Systems, Redondo Beach, Calif. Power Systems Div.
VOYAGER CAPSULE ENGINE SYSTEM DESIGN CONSIDERATIONS SINGLE VERSUS MULTIPLE ENGINE CONFIGURATION
16 Jun. 1967 53 p ref
(NASA-CR-94539) CFSTI: HC$3.00/MF$0.65 CSCL 21H

Advantages of various engine configurations for the Voyager capsule bus propulsion were considered on the basis of using positive seal squib valves to enclose the propellants in the tankage until they are required for either landing or landing and deorbit, with liquid engines in the case of the latter. Six, three, and one engine systems were compared; and it was assumed that the liquid

engines used for deorbit are fixed thrust versions of the throttleable engines used for the lander vehicle. Mission reliability, failure sensing equipment, and checkout and countdown reliability are considered; as are interacting failure modes, system performance and weight, vehicle configuration, and flight control. Leakage, plumbing, and contamination; feed system dynamics; electrical, EMI, and power requirements; and telemetry requirements are reported. Base heating, spacecraft heat load, engine and propulsion system development efforts are also described. M.W.R.

N68-23222# Army Mobility Equipment Command, Fort Belvoir, Va. Research and Development Center.

HIGH-SPEED INDUCTION MOTOR SIMULATION Research Report, Aug. 1966–Aug. 1967

Melvin L. Goss Feb. 1968 52 p refs

(Rept.-1920; AD-666762)

Covers a study on a simulation of a 50-horsepower high-speed induction motor on an analog computer. The investigations described in the report are intended to accomplish several purposes. One purpose is to develop in more detail the simulation equations from the dynamic equations provided on induction motors in recent machinery textbooks. A second purpose is to illustrate the determination of per-unit and amplitude scaled equations, and the calculation of potentiometer and amplifier gains. Another purpose is to record in detail the induction motor variables simulated for assistance and comparison in performing future work in this area of simulation. The results of this induction motor simulation provide a base from which to approach more complex control and application simulations which contain the induction motor as a component such as proposed electrical propulsion systems for various land vehicles. Author (TAB)

N68-23223# Army Mobility Equipment Command, Fort Belvoir, Va. Research and Development Center.

FUEL CELL-ELECTRIC PROPULSION TEST RIG (MODIFIED M-37, 3/4-TON CARGO TRUCK) Engineering Report, Jul. 1965–Dec. 1967

Lonnie D. Gaddy, Jr. Feb. 1968 49 p ref

(Rept.-1921; AD-666763)

This report covers a study to determine experimentally the feasibility and practicability of a fuel cell and electric drive propulsion system. The experimental data were obtained by testing the fuel cell test rig components and system. The report concludes that: The fuel cell and electric drive are feasible; the fuel cell-electric propulsion system performs satisfactorily; the use of a fuel cell as compared with other power plants such as a battery does not pose additional electrical problems; major technical advances are required. Author (TAB)

N68-23321* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AUXILIARY ELECTRIC PROPULSION STATUS AND PROSPECTS

William R. Mickelsen (Colorado State Univ.) and William C. Isley 10 Apr. 1968 28 p refs Presented at the 5th Symp. on Advanced Propulsion Concepts, Chicago, 8–10 Apr. 1968

(Grant NGR-06-002-032)

(NASA-TM-X-61074) CFSTI: $3.00 CSCL 21C

Major directions of hardware development and applications in spacecraft auxiliary electric propulsion are summarized, along with the status of the prime onboard operational systems and flight experiment systems. A single nozzle version of resistojet that was successfully flown on a Vela 3 spacecraft is shown that heats the conventional nitrogen propellant to a higher temperature using an electrical heater and thermal insulation on the thrustor body. Another resistorjet, used in ATS vehicles, places emphasis upon obtaining fast heatup of the propellant contact surface by minimizing the thermal mass of the heating region. Resistojet programs in the experimental stages include an ammonia thermal storage system, a cesium contact ion microthrustor with beam vectoring capability, and pulse plasma thrusters. Advanced concepts discussed include the Manned Orbiting Research Laboratory (MORL) with biowaste propellant, supersonic heat addition in electrothermal thrustors, high voltage solar cell arrays, and an autogenically-controlled cesium or colloid electronuclear thrust system. M.W.R.

N68-23335*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PLASMA CHARACTERISTICS OF THE ELECTRON BOMBARDMENT ION ENGINE

T. D. Masek 15 Apr. 1968 35 p refs

(Contract NAS7-100)

(NASA-CR-94554; JPL-TR-32-1271) CFSTI: HC $3.00/MF $0.65 CSCL 21C

An analytical study is presented as a first step in developing a model for engine operation. Solutions for the plasma potential distribution and the ion beam current are derived in terms of the electron and ion temperatures and densities. Experimental data, obtained with a Langmuir probe in mercury and cesium engines, are used to determine coefficients required in the plasma potential solutions. The use of these coefficients in the ion beam solution produced results consistent with Faraday probe measurements of the beam current. Author

N68-23354*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INVESTIGATION OF A NEARLY ISENTROPIC MIXED COMPRESSION AXISYMMETRIC INLET SYSTEM AT MACH NUMBERS 0.6 TO 3.2

Donald B. Smeltzer and Norman E. Sorensen Washington May 1968 152 p refs

(NASA-TN-D-4557) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A 20-inch capture diameter model of a mixed-compression axisymmetric inlet system was designed and tested. The inlet system was 1.4 capture diameters long measured from the cowl lip to the engine face. The design Mach number was 3.0, and off-design performance was obtained by translation of the cowl. Vortex generators were employed just downstream of the throat to reduce the total-pressure recovery, and total-pressure distortion at the engine face. Tests were conducted over the Mach number range 0.6 to 3.2 at angles of attack from 0° to 8° and at a tunnel total pressure of 15 psia. The supersonic diffuser of the inlet was designed with the aid of a computer program which employs the method of characteristics. The subsonic diffuser was designed to have a linear variation of Mach number from the end of the throat to the engine face. Results indicated a level of performance at Mach number 3.0 of 90 to 93 percent total-pressure recovery at the engine face with a bleed mass-flow ratio of 7.5 to 12 percent and a total-pressure distortion level of about 10 percent. Author

N68-23427# Illinois Univ., Urbana. Charged Particle Research Lab.

CHARGED COLLOIDAL SIZED PARTICLES FOR PROPULSION Final Report, Nov. 1965–Dec. 1967

31 Jan. 1968 14 p refs

(Grant AF-AFOSR-107-66)

(CPRL-1-68; AFOSR-68-0527; AD-666688)

A review of research results is given in the fields of electrostatic spraying, and control of fluids in accelerated and low gravity environment. TAB

N68-23432*# Rocketdyne, Canoga Park, Calif.
TWO-STAGE BIPROPELLANT INJECTION SYSTEM STUDIES Final Report
Paul F. Mehegan 30 Aug. 1967 266 p refs
(Contract NAS3-7962)
(NASA-CR-72303; R-7199) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The two-stage bipropellant injection system program was initiated to investigate hot-gas injection in combination with large-thrust-per-element injector concepts. Analyses and cold-flow experiments were used to guide the selection of injector concepts to be evaluated during hot-firing tests. Twenty hot-firing tests were conducted to evaluate the performance and stability of four different injectors. The test results proved feasibility of the principle and also demonstrated that stable operation and high combustion efficiencies of at least 97.5% were possible with a single-element 20,000-pound-thrust injector. Author

N68-23477*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF MERCURY PROPELLANT FEED ISOLATORS FOR KAUFMAN THRUSTERS
Shigeo Nakanishi Washington May 1968 29 p refs
(NASA-TM-X-1579) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Electrical breakdown voltages and leakage currents were experimentally determined for seven high-voltage isolator configurations designed for the mercury propellant feed system of a SERT II type Kaufman ion thruster. An isolator containing 40 insulated segments experienced no breakdown up to 5000 volts, but leakage current at 3000 volts was about 0.10 milliampere. A configuration utilizing a long propellent flow passage and large recombination surface areas operated at 3000 volts potential difference with a leakage current of less than 0.003 milliampere. Minimum breakdown voltage was 4400 volts. Author

N68-23541*# Dow Chemical Co., Freeport, Tex.
STUDY TO DETERMINE AN IMPROVED METHOD FOR APOLLO PROPELLANT SYSTEM DECONTAMINATION AND PROPELLANT TANK DRYING Final Report
H. G. Smith, J. C. Williams, and G. C. Mattson [1967] 215 p refs
(Contract NAS9-4605)
(NASA-CR-62069) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Laboratory bench-scale experiments were conducted to assess the compatibility of solvent with propellant and components, decontamination methods, solvent efficiency, temperature effects, diffusion rates of propellants from the elastomers, and removal of propellants from the flushing solvents. A literature survey on the decontamination of rocket propulsion systems was also undertaken. Pressure-cycled, vapor phase cleaning was found to have several advantages over liquid flushing such as the time requirement of less than one-half day at a cost of about $600 versus one full day with an estimated cost of over $11,000. Continued use of methanol and of Freon MF as the cleaning solvents is recommended. Based on the experimental findings, a test unit was designed and constructed. This consisted of a test vessel, pumps, solvent storage tanks, heat exchangers, a vent gas scrubber, a filter, absorption and drying columns, instruments, and the necessary piping and control valves. Tests conducted in the titanium vessel, scaled to approximately 1/20th the size of an Apollo service module propellant tank, confirmed the economical and time saving advantages of the pressure-cycled vapor phase cleaning method. M.G.J.

N68-23894*# Rocketdyne, Canoga Park, Calif.
A STUDY OF IGNITION PRESSURE SPIKING IN ATTITUDE CONTROL ENGINES. VOLUME 1: EVALUATION OF THE USE OF CATALYTIC SURFACES TO ELIMINATE IGNITION PRESSURE SPIKING Final Report, 1 Jul. 1966–30 Apr. 1967
R. N. Gurnitz, T. R. Mills, and G. L. Falkenstein May 1967 110 p refs
(Contract NAS9-6134)
(NASA-CR-62070; R-7060-1, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 21B

A study was conducted to evaluate the effect on ignition pressure spiking of the incorporation of catalytic surfaces into the injector of a nominally 91-pound-thrust Apollo Command Module RCS engine. Test firings at a simulated altitude of 150,000 feet over a range of propellant and chamber temperatures (0 to 160°F) and a range of relative valve timings (+20 to −20 milliseconds) with both blank (unmodified) and catalytically modified splash plate injectors were made for N_2O_4/MMH, N_2O_4/50–50, and N_2O_4/N_2H_4 propellant combinations. It was determined that the catalytic concepts employed did not eliminate or suppress the spiking. Effects on spiking levels of propellant combination, temperature, and valve timing were noted and are discussed. Author

N68-23947*# Rocketdyne, Canoga Park, Calif.
A STUDY OF IGNITION PRESSURE SPIKING IN ATTITUDE CONTROL ENGINES. VOLUME 2: A COMPARISON OF NITROGEN TETROXIDE/MONOMETHYLHYDRAZINE AND HYDROGEN PEROXIDE/MONOMETHYLHYDRAZINE IGNITION PRESSURE SPIKING CHARACTERISTICS
R. N. Gurnitz, T. R. Mills, J. D. Cordill, and G. L. Falkenstein May 1967 62 p refs
(Contract NAS9-6134)
(NASA-CR-62071; R-7060-2, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The noncatalytic altitude ignition characteristics of the N_2O_4/MMH and 98 percent H_2O_2/MMH propellant combinations are compared. All tests were conducted with a 91-pound-thrust, 150-psia chamber pressure combustor with a 16-element (unlike doublet) splash plate design injector. The simulated altitude was 150,000 feet; nominal temperatures were 100°F. The two firings with the H_2O_2/MMH propellants resulted in injector-damaging pressure spikes in the 3500-psi range. These were considerably in excess of the average ignition spikes of 325 psi noted during the 114 N_2O_4/MMH tests. The effects of valve timing and ignition delay on spiking for the N_2O_4/MMH combination were noted and discussed. For this propellant combination, uncorrected efficiencies of approximately 94 percent were found. Author

N68-23999*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.
DEVELOPMENT OF LIQUID OXYGEN/LIQUID HYDROGEN THRUST CHAMBER FOR THE M-1 ENGINE
R. J. Barsotti, S. C. Datsko, R. Louison, R. J. Kovach, D. J. Miller et al 15 May 1968 302 p refs
(Contract NAS3-2555)
(NASA-CR-54813; AGC-9400-5) CFSTI: $3.00 CSCL 21H

The current technology for large-scale liquid oxygen/liquid hydrogen thrust chamber designs is summarized. A thrust chamber using a coaxial element face injector and an ablative-lined uncooled chamber was successfully designed and tested. The injector incorporates copper baffles to preclude instability. These baffles are cooled by a combination of convective and film cooling. The conical chamber has an inside diameter of 40-in. at the injector, a throat diameter of 30-in., and measures 30-in. from the injector to the throat. The test results show that satisfactory start and shutdown transients as well as operation and performance were achieved with the first unit tested. The sea-level specific impulse achieved at a 2:1 expansion ratio was 306 sec and when extrapolated to a 40:1 altitude chamber results in a value of 430 sec. The M-1 coaxial element injector demonstrated a considerable margin of stability, both hydraulically and acoustically, at nominal design conditions. Author

N68-24000*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IGNITION SYSTEM FOR THE ATS ROCKET MOTOR
Thomas P. Lee 1 Feb. 1967 43 p refs
(Contract NAS7-100)
(NASA-CR-94620; JPL-TM-33-317) CFSTI: HC $3.00/MF $0.65 CSCL 21B

This report documents the design, development, testing, and qualification of an igniter system for the solid-propellant Applications Technology Satellite (ATS) apogee rocket motor. The rocket motor contains 760 lb of propellant with about 898 sq in. of initial burning surface to be ignited. The L^* at ignition is 140. The development phase started with a scale-up of the Syncom I igniter and rapidly progressed to an internally insulated aluminum basket with twelve gas ports and a pyrotechnic charge of 19 ALCLO pellets and two solid-grain ALCLO main grain charges. The igniter interfaces to either a development closure for data acquisition or to a safe-and-arm (S&A) device for flight and qualification testing. Ignition of the pyrotechnic charge is initiated either by a single dual-bridgewire squib for development testing, or two PC-37 squibs when used with the S&A device. The igniter, less closure or S&A, weighs 1 lb. Author

N68-24001*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
QUALIFICATION PHASE FOR THE APPLICATIONS TECHNOLOGY SATELLITE APOGEE ROCKET MOTOR Technical Memorandum, Jul.–Aug. 1966
D. R. Frank and R. G. Anderson 15 Sep. 1967 40 p refs
(Contract NAS7-100)
(NASA-CR-94621; JPL-TM-33-339) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The preparation, testing, and evaluation of the qualification phase for the Applications Technology Satellite apogee rocket motor are documented. A total of eight apogee motor assemblies were tested under simulated altitude conditions at the Arnold Engineering Development Center, Tullahoma, Tennessee, during July and August 1966. All units were tested while spinning at 100 rev/min. Four units were tested at each test temperature of 40 and 100°F. On December 7, 1966, the first flight firing of the apogee unit placed the ATS-B satellite into a near-synchronous, equatorial orbit. Author

N68-24008*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN, FABRICATION, AND TESTING OF THE APPLICATIONS TECHNOLOGY SATELLITE APOGEE MOTOR NOZZLE
Richard A. Grippi, Jr. 15 Jul. 1967 75 p
(Contract NAS7-100)
(NASA-CR-94619; JPL-TM-33-333) CFSTI: $3.00 CSCL 21H

This report documents the design, fabrication, and testing of the Applications Technology Satellite apogee motor nozzle. On firing, the apogee motor provides the necessary velocity increment, at the apogee of the elliptical transfer orbit, to place the satellite in a synchronous orbit. The nozzle construction consists of: (1) high-density, graphite throat insert, (2) tape-wrapped, carbon-cloth, phenolic-resin throat section, (3) tape-wrapped, silica-cloth, phenolic-resin exit cone, (4) aluminum attachment ring, and (5) an aluminum throat closure diaphragm. A length limitation was imposed on the propulsion system; therefore, the nozzle was submerged into the motor chamber to accommodate the 35:1 expansion ratio of the contoured nozzle. Verification of the nozzle design was accomplished through static motor firings and environmental tests, which included temperature cycle, booster acceleration, booster vibration, and space temperature vacuum exposure. On December 7, 1966, the first flight firing of the apogee unit placed the ATS-B satellite into a near-synchronous, equatorial orbit. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-23254*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE HIGH LATITUDE OUTER ZONE BOUNDARY FOR ≥ 40 KEV ELECTRONS AS OBSERVED BY SATELLITE INJUN 3
Theodore A. Fritz Mar. 1968 35 p refs
(Grant NsG-233-62; Contract Nonr-1509(06))
(NASA-CR-94535; Rept.-68-21) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The relationship of locally mirroring and precipitating ≥ 40 keV electrons was studied on magnetically quiet days. There was usually an enhancement of precipitating electrons at the high latitude boundary for all local times. On the night side the flux of electrons always approached isotropy over the upper hemisphere at the position of the satellite at this boundary. The condition of isotropy at the boundary was strongly dependent on local time; it was always present on the night side, but only infrequently with increasing local time toward local dusk (1800 hours), where isotropy was seldom observed. During magnetically quiet periods large intensities of ≥ 40 keV electrons were precipitating into the atmosphere for $\Lambda \geq 65°$. The position of the high latitude boundary (intensity cutoff) varied by $\Delta\Lambda \approx 7°$ at low magnetic activity. On the night side, the latitude where the ratio of the trapped to the precipitated ≥ 40 particle fluxes breaks toward one (ϕ-boundary) is introduced as a more meaningful concept of the high latitude limit to durably trapped ≥ 40 keV electrons than the usual intensity cutoff. The concept that the high latitude outer zone boundary at all local times is controlled or driven by a mechanism acting primarily on the night side is introduced. Author

N68-23445*# California Univ., La Jolla. Dept. of Physics.
PENETRATION OF SOLAR PROTONS TO FOUR EARTH RADII IN THE EQUATORIAL PLANE
R. Walker Fillius Mar. 1968 67 p refs Presented at the IAGA Comm. 5, Solar-Terrest. and Cosmic-Terrest. Relationship Conf., St. Gall, Switzerland, Sep. 1967
(Contract NAS5-3063; Grant NsG-538)
(NASA-CR-94569; UCSD-SP-68-3) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Solar protons in the 40 to several hundred MeV range were monitored by Explorer 26 at low L values inside the boundary of trapped radiation near the geomagnetic equator on February 5, 1965, and on March 24, July 7, August 28, and September 2, 1966. The spatial distribution was characterized by a plateau of constant intensity, bordered by a region of east-west symmetry below the particle cutoffs of some directions of arrival, and terminated by the final cutoffs for eastbound particles. The cutoffs are below their classical Stormer values, but they are empirically described by a modified Stormer theory. The cutofff altitudes are lowered during the magnetic storm, and our limited sample correlates better with K_p than with D_{st}. It can be shown that a symmetrical ring current is expected to raise the equatorial cutoffs, so that some other mechanism is needed to account for the storm effect. The geomagnetic tail may account for this mechanism. The particles seen in these events show no evidence for merging with the trapped radiation and becoming permanently trapped. Author

N68-23538*# LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.

ANALYSIS OF POLAR CAP EVENTS 4: ALMOST NECESSARY AND/OR SUFFICIENT CONDITION FOR SOLAR PROTON WARNING

Fred C. Jonah 8 Feb. 1967 92 p refs

(Contract NAS9-4911)

(NASA-CR-62067; Rept.-00.882) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A summary is presented on the data analysis used in the search for an observational technique that will distinguish flares that were followed by a polar cap absorption event from those that were not. The three solar or solar induced conditions or phenomena that appear to be almost sufficient or necessary conditions for predicting that a flare will be followed by a PCA event are given, and possible modification, combinations, and problems associated with some of these conditions are discussed. An assessment is made of the major RF and solar events occurring during the period June 1957 to January 1963. B.S.D.

N68-23676 Yale Univ., New Haven, Conn.

NEUTRINO EMISSION FROM DENSE STELLAR INTERIORS

Carl John Hansen (Ph.D. Thesis) 1966 148 p

Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-77

Some neutrino producing mechanisms are discussed which are of importance in dense stellar interiors. The rates of neutrino emission from electron decay and capture, and position decay (the nuclear URCA processes) are computed for the ranges of density and temperature $10^6 \leq \rho \leq 10^{10}$ gm/cm^3 and $10^9 \leq T \leq 10^{10}$°K for 200 nuclei with mass numbers A = 12 to 61 clustered around the beta stable valley. The rate for the modified URCA process is derived which is important in the density regime $10^{13} \leq \rho \leq 10^{16}$ gm/cm^3. The result is used to compute the rates of decrease of thermal and oscillatory energies of vibrating neutron stars in an effort to account for the energy source of X-ray emission observed from known supernova remnants. The conclusion is reached that neutrino losses decrease neutron star surface temperatures below the observed limit in a very short time. Damping of oscillations by the same mechanism does not appear to be fast enough to rule out a vibrational source of energy. Dissert. Abstr.

N68-23691*# Volt Technical Corp., Washington, D. C.

ELECTRONS OF NATURAL ORIGIN IN THE INNER RADIATION ZONE [ELEKTRONY YESTESTVENNOGO PROISKHOZHDENIYA VO VNYTRENNOY RADIATSIONNOY]

V. V. Temnyy Goddard Space Flight Center, Greenbelt, Md. NASA 13 May 1968 11 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 2, 1968 p 235-241

(Contract NAS5-12487)

(NASA-CR-94595; ST-PF-10713) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Following were the characteristics of stationary distribution of electrons of natural origin in the inner radiation zone, with energy > 40 kev, on the basis of measurements on AES Kosmos-3 and -5 in 1962 and Elektron-1 and -3 in 1964: the presence of intensity maximum (2×10^9 electron/cm^2) sec in the equatorial plane between L = 1.6 and 1.8; the dependence of intensity on parameters L and B over drift trajectories with $h_{min} > 700$ km and longitudinal dependence of intensity on trajectories with $h_{min} < 700$ km; the rate of losses from the region of maximum trapping is equal to (2×10^{-8} electron/cm^3) sec. On the basis of comparison of the obtained distribution of electrons with 11 measurements of electrons on various satellites and rockets, conducted from 1958 through 1966, the conclusion could be drawn about the stability of intensity of electrons of natural origin in the inner radiation zone in the course of the 11-year cycle of solar activity. Author

N68-23692# Smithsonian Institution, Washington, D. C.

SOME ADDITIONAL ASPECTS OF THE UNEQUAL ACTIVITY OF THE NORTHERN AND SOUTHERN SOLAR HEMISPHERES: MICROWAVE RADIO BURSTS AND SWFS, VOLUME 10, NUMBER 4

Gladys A. Harvey and Barbara Bell 1968 13 p refs

The relative activity of the Northern and Southern Hemispheres in the production of solar and solar-linked terrestrial events is investigated for the period July 1957 through December 1960, with particular attention to shortwave fadeouts (SWFs) and to microwave radio bursts, including those observed at 2800 MHz at Ottawa. The magnitude of the microwave bursts is investigated, by hemisphere, in relation to three terrestrial effects: polar-cap-absorption (PCA) events, geomagnetic storms, and SWFs. As with solar flares, geomagnetic storms, and PCA events, the percentage of microwave bursts associated with the Northern Solar Hemisphere increases with increasing importance of the event, to around 90% for bursts of integrated intensity $\geq 10^5$, great magnetic storms, and PCA events with absorption ≥ 10 db. This substantially exceeds the percentage of all sunspot groups (2692-59% N) and of the largest spot groups with mean area ≥ 1000 millionths of the solar disk (40-68% N). In unexpected contrast, a relatively low percentage of major (3, 3+) SWFs are found to come from the Northern Solar Hemisphere (59% N). The hemispheric distribution of the greatest bursts appears to account for that of the PCA sources, but not for that of the sources of great storms or major SWFs. Author

N68-23747 California Univ., Los Angeles.

THE MODULATION OF GALACTIC COSMIC RAY ELECTRONS, PROTONS, AND ALPHA PARTICLES AT SOLAR MINIMUM

Reuven Ramaty (Ph.D. Thesis) 1966 178 p

Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-542

The modulation of galactic cosmic rays (protons, alpha particles, and electrons) due to the interaction of the cosmic radiation with the electromagnetic fields in the solar system is studied. This modulation is caused by the scattering of the incoming galactic particles by magnetic irregularities carried by the outflowing solar wind. The resulting processes of diffusion, convection and energy loss by deceleration are treated in terms of the relativistic Boltzmann equation. An anisotropic diffusion equation, including energy losses, is derived by expanding the angular part in momentum space of the distribution function in spherical harmonics. The moment equations, which are used to derive the diffusion equation, are obtained by integrations over momentum space angle only. Unlike previous treatments, this approach does not eliminate the energy as an independent variable. The expected effects of diffusion, convection, and energy loss are presented and a simple formalism for the study of the modulation is deduced. Dissert. Abstr.

N68-23752*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

AN IMPROVED MODEL FOR COSMIC RAY PROPAGATION

Peter D. Noerdlinger Apr. 1968 21 p refs

(Grant NsG-233-62)

(NASA-CR-94593) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A model for cosmic ray propagation derived by Jokipii is modified to take into account particle mirroring. This removes the unreasonable sensitivity of the original theory to the extreme high frequency end of the interplanetary magnetic field power spectrum P(f). It is then possible to relate the diffusion coefficient for particles of known velocity and rigidity to a limited portion of the field spectrum. Author

N68-23799# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.

SUPPLEMENT TO IQSY INSTRUCTION MANUAL NO. 10 COSMIC RAY TABLES. ASYMPTOTIC DIRECTION, VARIATIONAL COEFFICIENTS AND CUTOFF RIGIDITIES

M. A. Shea, D. F. Smart, K. G. McCracken (Adelaide Univ.), and U. R. Rao (Phys. Res. Lab.) Jan. 1968 210 p refs *Its* Spec. Rept. No. 71

(AFCRL-68-0030; AD-667539)

The report is a supplement to IQSY Instruction Manual No. 10, Cosmic Ray Tables by McCracken, et al. (1965), and contains the asymptotic directions, variational coefficients and cutoff rigidities for 48 stations not included in the original manual in addition to an explanatory text. The computer programs utilized to calculate the values given in the tables are given in the appendix. Author (TAB)

N68-23858# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.

THE INFLUENCE OF RADIO BRIGHTNESS TEMPERATURE ON SOLAR FLARE PREDICTION

Alfred E. Reilly and Isadore Enger (Travelers Res. Center, Inc.) Dec. 1967 15 p refs *Its* Surv. in Geophys., No. 200

(AFCRL-67-0670; AD-667535)

An objective technique based on two measured parameters has been developed to determine the probability of occurrence of a solar flare near a sunspot group. The parameters utilized were the size of each sunspot group and the magnitude of an associated radio brightness temperature. Flare, sunspot, and radio data measured daily during the period from April 1962 through October 1966 were used in the study. These data were associated objectively and analyzed statistically. The size of a sunspot group is a significant predictor in itself. This analysis shows that consideration of radio brightness temperature significantly improves the accuracy of solar flare prediction beyond the accuracy that can be achieved by considering only the size of the sunspot group. Author (TAB)

N68-23885 Kodaikanal Observatory (India).

KODAIKANAL OBSERVATORY BULLETIN NUMBER 167

26 Apr. 1967 317 p

Observational results of solar calcium prominences during the second half of 1961 are presented together with data derived from photographs during cloudy sky conditions. Analysis of spectroheliograms revealed that mean daily areas of prominences decreased 14.2% and that mean daily numbers of prominences increased about 10.3%. The distribution of areas and numbers in five degree ranges of latitude shows a peak of activity in the Northern Hemisphere in the latitude belt 20°–25° whereas the numbers show maximum activity in the belt 45°–50°. Southern hemisphere peaks of activity of both area and numbers were observed in the latitude belts 15°–20° and 50°–55°. G.G.

N68-23904# Aerospace Corp., El Segundo, Calif. Space Physics Lab.

A REYNOLDS EQUATION THEORY OF SOLAR DIFFERENTIAL ROTATION AND MERIDIONAL CIRCULATION

Yam T. Chiu Mar. 1968 40 p refs

(Contract F04695-67-C-0158)

(TR-0158(9260-02)-3; SAMSO-TR-68-137; AD-667788)

An incompressible hydrodynamic theory of solar photospheric rotation and circulation is formulated in terms of Reynolds equations. The dynamical hypothesis of local axisymmetric turbulence is used to reduce the number of turbulent stress tensor components. Partial solution yields a circulation pattern in good agreement with experiment, predicting a node at co-latitude 50 degrees. Using the equatorial rotation velocity, 2 x 10 to the 5th power cm/sec, and the surface differential to pure rotation ratio, -1/5, as input parameters, the circulation velocity components and the microturbulence root mean square velocities are found to be in good agreement with experiment. Furthermore, the angular momentum per unit volume along a radial direction is found to be constant. This result agrees with and lends support to the thesis, due to Biermann and Kieppenhahn, that circulation is driven by non-potential parts of the rotation velocity field. Author (TAB)

N68-23939# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.

OBSERVATION AND FORECASTING OF SOLAR PROTON EVENTS

John P. Castelli *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968, Vol. 1 21 Mar. 1968 25 p refs (See N68-23931 13-34)

Solar burst characteristics in the radio band are used to differentiate between flares that might produce proton events and large flares that would not. Based on study of the radio characteristics of large flares, it has been determined that only flares that have high flux density in the microwave region with a particular spectral configuration produce protons. Proton events, which produce high level absorption, disrupt polar communications, and are potentially dangerous to man in space, may precede auroral, and magnetic storms which disturb many radio wave propagation systems. It is concluded that the probability of a proton event can now be established on the basis of these findings. Author

N68-23966# Lund Univ. (Sweden).

A SEARCH FOR THE FORBIDDEN LINES OF SILICON IN THE FRAUNHOFER SPECTRUM

J. W. Swensson 1967 5 p refs Conf. Presented at the Royal Physiographic Soc., 24 Sep. 1967 *Its* Ser. 2, No. 24

CFSTI: HC $3.00/MF $0.65

A search has been made in the solar spectrum for the forbidden lines arising in the ground configuration, $3s^23p^2$, of neutral silicon. The strongest of these lines, $^1D_2-{}^1S_0$ at λ 10,991.41, very nearly coincides with the telluric feature, due to water vapor, at λ 10,991.39 and on "dry" spectrograms may contribute significantly to the blend. No evidence is found for the members of the multiplets $^3P-{}^1D$, near λ 16,000, and $^3P-{}^1S$, near λ 6500. It is suggested that the photospheric silicon abundance derived by Aller, O'Mara, and Little is too high by a factor of at least two. Author

N68-23967# Lund Observatory (Sweden).

ON THE BALANCE OF MAGNETIC FLUXES IN SUNSPOT GROUPS

Jan Olof Stenflo 1967 24 p refs Conf. Presented at the Royal Physiographic Soc., 24 Nov. 1967 *Its* Ser. 2, No. 35

CFSTI: HC $3.00/MF $0.65

The magnetic fluxes in sunspot groups have been measured on 17 isogauss maps obtained at the Crimean Astrophysical Observatory in 1963 and 1965. The measured fluxes are represented in the form of histograms giving the flux per unit interval of the longitudinal field strength. If only the strong fields (sunspot fields) are taken into account, there is a very strong disbalance between the fluxes in the region. For the weaker fields, however, there is a disbalance in the opposite sense. In this way a total balance between the fluxes is almost obtained. An important property of sunspot groups is their east-west asymmetry. The magnetic lines of force are generally more concentrated in the preceding part of the region than in the following part, where they are spread out over a larger area. Author

N68-23978# Lund Observatory (Sweden).

MEASUREMENTS OF THE SUN'S MAGNETIC FIELD

Jan Olof Stenflo 1968 37 p refs Presented at the Royal Physiographic Soc., 2 Jan. 1968 *Its* Ser. 2, No. 1

CFSTI: HC $3.00/MF $0.65

The magnetic field outside active regions on the sun has been studied with the double magnetograph of the Crimean Astrophysical Observatory. Records of the magnetic fine structure were obtained near the heliographic central meridian at the latitudes +75°, −01°, −32° and −63° using four different slit sizes. The results obtained in 1965 about the increase of the measured magnetic fluxes with decreasing slit size have been confirmed. A displacement of the zero line on the strip-chart can give a serious systematic error. Using two magnetographs simultaneously, it has been possible to find the true position of the zero line. Before correcting for the error in the zero line, there was an apparent disbalance between the net fluxes at the north and south poles of the Sun, but after correction the balance was restored. If the influence of the slit size is neglected and the results obtained with the four slits are averaged, the absolute field strength is found to be 4.0 gauss at both the heliographic poles. The residual disbalance between the poles is only 0.04 gauss or 1 percent, which is well inside the observational errors. At all the latitudes studied, periodic variation of the magnetic field with the heliographic longitude is indicated, the period of the variation being one solar rotation.
Author

N68-23991 Kodaikanal Observatory (India).
THE COSMIC RAY FLARE OF MARCH 7, 1942
K. R. Sivaraman and L. M. Punetha 1967 8 p refs *Its* Bull. No. 179, Ser. A

The variation of the dynamic characteristics of the cosmic ray limb flare of March 7, 1942 based on the K_{232} spectroheliograms and H-alpha spectrohelioscope observations of Kodaikanal is presented. Although the flare had high flare ribbon velocities of the order of 17 km/sec. during the flash phase with subsequent changes in its configuration, its effect on the nearby prominence was trivial. The loop prominence with typical condensations and knots formed at height of 30,000 km. above the limb and connected to the chromosphere by thin curved threads was noticed, about 1-1/2 hours after the flash phase.
Author

N68-24039# RAND Corp., Santa Monica, Calif.
VARIABLE GALACTIC X-RAY SOURCES IN HYDROMAGNETIC WAVES
R. E. Le Levier and L. Marshall Libby Apr. 1968 10 p refs
(P-3798; AD-667783)

Galactic X-ray sources of fluctuating intensity are explained as being small regions of enhanced gas density temperature emitting thermal Coulomb bremsstrahlung of keV energies. Hydromagnetic wave motions of the magnetic fields in the galactic spiral arms produced the enhanced regions by compressing the ionized gas clouds to which they are tied by their high electrical conductivity. From the observed periods of fluctuation of a few months together with the hydromagnetic velocity the average source size is estimated at greater than or equal to 10 to the 16th power cm. By using the formula for Coulomb bremsstrahlung and requiring that the sources shall produce the observed X-ray fluxes a second estimate of source size is found to be in agreement at approximately 10 to the 16th power cm. Such regions are too small to be observable radio sources with presently existing radio telescopes.
Author (TAB)

N68-24050# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
A COMPARISON OF REPORTED SOLAR FLARE OCCURRENCE TIMES AND FLARE PATROL TIMES, 1955–1964
Ronald T. Podsiadlo and Helen R. Baker Dec. 1967 18 p *Its* Spec. Rept., No. 69
(AFCRL-67-0695; AD-667805)

A flare event list that is consistent with flare patrol times is prerequisite to a reliable, unbiased estimate of flare occurrence per unit patrol time. A comparison of the flare occurrence times and flare patrol times reported by 52 solar observatories during the period of 1955 to 1964 discloses that 12.3 percent of the flare reports (Importance = or > 1) have no reported patrol coverage. Elimination of these unpatrolled flare reports reduces the number of individual flare events in the data sample by 9.7 percent. This means that flare occurrence per unit patrol time computed from the raw flare and flare patrol data is overestimated by this same percentage. In addition to eliminating unpatrolled flare reports, appropriate adjustments are made in the patrolled flare data so as to make each observatorys reported flare times completely consistent with its reported patrol times.
Author (TAB)

N68-24299# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
THE SOLAR EXTREME ULTRAVIOLET SPECTRUM BETWEEN 30 MARCH 1966 AND 17 JANUARY 1967 Interim Scientific Report
James E. Higgins Jan. 1968 17 p refs *Its* Environ. Res. Papers No. 280
(AFCRL-68-0009; AD-667538)

The solar extreme ultraviolet spectrum, in the wavelength range 226A to 1266A, is presented for data obtained from three rocket-borne spectrometers launched during the period 30 March 1966 to 17 January 1967. A positive correlation between the 10.7 cm solar flux and the intensities of the 284.2A Fe XV and 335.0A Fe XVI lines is shown to exist.
Author (TAB)

N68-24301# Boston Univ., Mass.
A STUDY OF SOLAR RADIO BURSTS IN THE 3.4 TO 50 CM RANGE AND THEIR CORRELATION TO SCNA EVENTS Final Scientific Report, 1 Nov. 1962–31 Oct. 1967
Federico M. Strauss and Michael D. Papagiannis Jan. 1968 18 p refs
(Contract AF 19(628)-2350)
(AFCRL-68-0100, Pt. 3; AD-667543)

We have conducted a statistical study of the correlation between solar radio bursts and sudden cosmic noise absorption events. Our main purpose was to study the relative effectiveness of the different microwave frequencies in detecting the radio bursts that are associated with X-ray emission from the Sun. In the frequency range covered (606 to 8800 MHz), it was found that the higher the monitoring frequency, the better the correlation with X-ray emission. It was also found that for centimeter wavelengths the correlation improves as the radio bursts become more intense whereas for decimeter wavelengths this was not found to be true.
Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-23139*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
BRIGHT STAR OBSERVATIONS USING AN UNFILTERED 1P21 PHOTOTUBE
L. L. Smith and H. C. Courten Feb. 1968 12 p refs Presented at the 125th Meeting of the Am. Astron. Soc., Philadelphia, 4–7 Dec. 1967
(Contract NAS5-9166)
(NASA-CR-94347; RM-406J) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Photoelectric observations of bright stars have been made using the LPL (Lunar and Planetary Laboratory) 21 inch telescope and calibrated 1P21 phototube, infiltered. A color index, [m(S-4)-V] versus (B-V) calibration curve, was derived with the zero-point set for AO stars. The measured magnitude over the response of the phototube is m(S-4), and V and (B-V) are the magnitude and color, respectively, in the UBV system. The calibration curve is linear between (B-V) = 0.00 and +1.00 and reaches limiting values of [m(S-4)-V] = −0.61 and +0.99 for (B-V) = −0.23 and +1.64, respectively. A theoretical curve, based on a formula derived by Davenport, relating m(S-4) to the existing UBV measurements differed from the observed curve by ±0.05 mag (p.e.) with the later spectral classes having the larger differences. Line blanketing becomes important in these cooler stars and becomes increasingly difficult to take into account in the computed magnitudes. Author

N68-23150# International Business Machines Corp., Cambridge, Mass. Advanced Space Systems Dept.

PROGRAM SOLUTIONS TO SPACE SCIENCE PROBLEMS Final Scientific Report, Aug. 1966–Feb. 1968

Louise Coury Feb. 1968 61 p refs

(Contract AF 19(628)-6065)

(AFCRL-68-0046; AD-666687)

Describes the analysis and programming required in the development of three computer programs which cover a wide variety of scientific research. Some of these investigations are inter-related, such as the geomagnetic co-ordinate conversion and magnetic field determinations, while others range from radar-trajectory analysis to electromagnetic theory. For each case, this report describes the mathematical development as well as the programming aspects in order to more completely define the problems and increase their applicability. While the problem descriptions of this document are mathematically oriented, the sections explaining the programming aspects of each problem are designed to facilitate the use of the computer programs by programmer and scientist alike. The specific topics covered in this report are: Orbiting Geophysical Observatory; Trajectory analysis for single station radar; Magnetic field and B and L determination. Author (TAB)

N68-23269*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PERIODIC ORBITS IN THE RESTRICTED THREE BODY PROBLEM WITH EARTH–MOON MASSES

R. A. Broucke 15 Feb. 1968 97 p refs

(Contract NAS7-100)

(NASA-CR-94555; JPL-TR-32-1168) CFSTI: HC $3.00/MF $0.65 CSCL 03C

A systematic numerical investigation has been made of symmetric periodic orbits in the restricted three-body problem with two dimensions and with earth–moon mass ratio. Several thousands of periodic orbits have been obtained by numerical integration and have been classified in families. The present report describes 1811 periodic orbits, which are contained in 10 of the most important families. They represent most of the simpler forms of periodic orbits that are symmetric with respect to the syzygy axis. In order to have reasonable assurance of the consistency of our classification, the orbits of each family have been computed with a somewhat greater than usual density, as compared with many other publications on this subject. However, no mathematical proofs are given here for the subdivision into families. The report contains an elementary theoretical introduction to the restricted three-body problem preceding the description of the orbits and their stability. Tables with the numerical data of the orbits have also been included. Author

N68-23316*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

COMPUTER SIMULATION OF THE EVOLUTION OF SPIRAL GALAXIES

Frank Hohl 4 Apr. 1968 33 p refs Presented at 126th Meeting of Am. Astron. Soc., Charlottesville, Va., 1–4 Apr. 1968

(NASA-TM-X-61081) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A two-dimensional model is used to perform computer experiments for a collisionless self-gravitating system. The gravitational field is obtained by solving the Poisson equation and the system is advanced stepwise in time. Computer simulations were performed for systems with an initially uniform distribution over a circular or elliptical region in x–y space, zero thermal velocity, and with given values of initial solid-body rotation. Up to 10,000 stars are used in the calculations. As such systems evolve in time they display the various shapes observed in actual galaxies. It is found that some of the calculations recently reported cannot be considered collisionless. Author

N68-23360*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LAUNCH WINDOW ANALYSIS FOR ROUND TRIP MARS MISSIONS

Larry A. Manning, Byron L. Swenson, and Jerry M. Deerwester [1967] 42 p refs Presented at the 5th Space Congr., Cocoa Beach, Fla., 11–14 Mar. 1968

(NASA-TM-X-61087) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Round trip missions to Mars have been investigated to define representative launch windows and associated ΔV requirements. This report presents results indicating the effects on the launch windows of velocity capability, transfer technique, and of the inclination, eccentricity, and insertion direction of the orbit. The analysis assumed a circular parking orbit at Earth and considers both circular and elliptical parking orbits at Mars. The study indicates that, using a three-impulse transfer, the ΔV penalty for non-coplanar departures is no more than 5–10% above the minimum coplanar requirements. Similar characteristics occur for elliptical parking orbits. However, due to the low coplanar ΔV's, they provide a longer launch window for a given total ΔV capability. Author

N68-23361* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ELLIPTIC CAPTURE ORBITS FOR MISSIONS TO THE NEAR PLANETS

Federico G. Casal, Byron L. Swenson, and Alfred C. Mascy [1965] 8 p refs Presented at the 5th Space Congr., Cocoa Beach, Fla., 11 Mar. 1968

(NASA-TM-X-61091) CFSTI: $3.00 CSCL 22C

Elliptic capture orbits around Mars and Venus have often been considered as means for reducing arrival and departure energy requirements for two-way missions. This paper presents the results of an analysis which takes into consideration the penalties arising from the requirement to match the orientation of the elliptical orbit with the asymptote of the departure hyperbola. Alignment of the semi-major axis of the capture ellipse relative to the asymptote of the escape hyperbola was found not to be a critical requirement. The sensitivity of the mass of the excursion module to the eccentricity of the capture orbit is discussed and mass-penalty diagrams are presented. It is shown that these penalties do not materially offset the large gains obtained through the use of the elliptical capture mode. Author

N68-23410*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN EXPOSITION ON HANSEN'S METHOD OF PARTIAL ANOMALIES

George E. Mc Cluskey, Jr. Aug. 1967 69 p refs

(NASA-TM-X-63184; X-552-67-381) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Hansen's method of partial anomalies is described and his application of the method to Encke's comet is discussed. The principal innovation of the method is to divide the ellipse of the perturbed body into a small number of segments. In each segment an

independent variable closely related to the conventional anomalies is selected in order that the series representing the perturbations is strongly convergent within the segment but is invalid outside of it. A different set of series is obtained for each segment of the ellipse. In the case of high eccentricity, these series can be made much more convergent than the conventional series. This method may be applied to the determination of the perturbations of artificial satellites and space probes with highly eccentric orbits. Any celestial object, natural or artificial, with an eccentricity greater than about 0.50 may be very efficiently dealt with by means of the method of partial anomalies. This method has the great advantage of being rapidly convergent for all eccentricities and of being semianalytic. Author

N68-23429*# Pennsylvania State Univ., University Park. Materials Research Lab.

COMPUTATION AND INTERPRETATION OF INSOLATION TABLES

William A. Schlosser, Raymond T. Greer, and Vladimir Vand 10 Apr. 1968 55 p refs Presented at the Spring Meeting of the Am. Geophys. Union, Washington, D. C.

(Grant NGR-39-009-015)

(NASA-CR-94531) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Computation of the insolation tables for the amount of sunlight received per square centimeter at any position of the planet's surface and at any time of orbit for the planet Mars has been programmed for the IBM 7074 computer. The values represent an extension and modification of previous work on insolation curves which had been compiled before the Mariner 4 results concerning the atmosphere of Mars were known. These new computed values have been applied to predict extraterrestrial atmosphere circulation patterns since the seasonal storage of insolation is small on Mars, and as a consequence the latitudinal gradient of ground temperature and the differential heating of the air should both vary seasonally on Mars in the same way as the effective insolation. Profiles and contour plots of computed insolation values taken from the tables compare favorably with changes in color patterns observed during the Martian year, suggesting that many of the striking Martian features depend on clearance and deposition of yellow dust which is influenced by the diurnal pattern of winds on Mars. Author

N68-23518*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE PATHS OF DIURNAL ARTIFICIAL EARTH SATELLITES

I. V. Aleksakhin, E. P. Kompaniets, and A. A. Krassovsky Redstone Arsenal, Ala. Redstone Sci. Inform. Center 28 Feb. 1968 18 p Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 4, Jul.–Aug. 1964 p 532–538 Prepared jointly with Army Missile Command

(NASA-TM-X-61093; RSIC-753) CSCL 22C

Working formulas are given for the determination of the paths of diurnal artificial earth satellites. There are introduced parameters of the paths and their dependence on parameters of the powered section of the carrier rocket trajectory is determined. Author

N68-23542* Northrop Corp., Huntsville, Ala. Nortronics-Huntsville.

ANALYTICAL RESEARCH IN GUIDANCE THEORY Final Technical Report, 15 Sep. 1966–31 Oct. 1967

J. F. Andrus, F. C. Heilscher, S. S. Hu, J. W. Newkirk, M. L. Thompson et al Nov. 1967 113 p refs

(Contract NAS12-500)

(NASA-CR-86053; TR-792-8-283; TR-351) CFSTI: $3.00 CSCL 22C

Series solutions are presented to two-point boundary condition problems that result from applying the calculus of variations to optimal guidance problems. Three different missions are considered: optimal ascent to circular orbit, optimal ascent to rendezvous with a circular orbiting target satellite, and optimal ascent to elliptical orbit. Effort was also directed toward simplification of the analytical processes, i.e., dropping of terms in formulas for the guidance functions when these terms do not significantly influence the answers, or approximating complicated formulas with simpler ones. Symbolic manipulation of polynomials is discussed with particular reference to the MULPO program, which was designed to multiply polynomials (with literal coefficients) in one to six variables. M.G.J.

N68-23576# General Electric Co., Schenectady, N. Y. Information Sciences Lab.

A SYNTHESIS METHODOLOGY APPLIED TO A SPACE VEHICLE SYSTEM Technical Information Series

D. C. Hogue Dec. 1967 24 p refs

(Rept.-67-C-229)

The synthesis of a system made up of many interconnected subsystems is complicated by the component interactions present. Given a set of system requirements or constraints, the objective is a system design that will produce the desired results. This requires that all component subsystems be compatible internally with the overall system requirements. A methodology has been developed to provide a more systematic approach to system synthesis. The method is based on partitioning concepts, with subsystems described in terms of input/output relationships. The system model is treated as a static network using the ADA computer program with ADOPT for parameter optimization. Development of the methodology and applying it to a space vehicle system are described. Author

N68-23585*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE OBSERVABILITY OF THE VELOCITY OF LIGHT

Gerald L. Smith [1967] 11 p Presented at the Goddard Astrodyn. Conf., 16–17 Apr. 1968

(NASA-TM-X-61090) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The purpose of this paper is to show that the knowledge of the velocity of light cannot be improved by simply adding it to the list of state variables in space vehicle trajectory estimation problems. It is shown that the velocity of light is an unobservable parameter in trajectory estimation and that its inclusion in the problem is not only inappropriate but also can lead to erroneous results. Although this is generally known, the present analysis illuminates the problem and gives some insight into other observability problems. It is also demonstrated that when the velocity of light uncertainty is considered, it is crucial that the correct *a priori* correlations be used in the estimation covariance matrix in order to avoid error. K.W.

N68-23595# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

NON-UNIFORMITY IN THE ROTATION OF THE EARTH ACCORDING TO THE DATA OF ASTRONOMIC OBSERVATIONS FOR THE PERIOD OF 1955.5–1965.0 [NERAVNOMERNOST VRASHCHENIYA ZEMLI PO DANNYM ASTRONOMICHESKIKH NABLYUDENIY ZA PERIOD 1955.5–1965.0 GG]

N. S. Sidorenkov Jan. 1968 23 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 44, no. 3, 1967 p 650–662

(ACIC-TC-1319; AD-667076)

The paper is a discussion of the following phases of the study of the non-uniformity in the rotation of the earth according to the data of astronomic observations: (1) Determining the changes in the velocity of the earths rotation. These changes may be detected only by way of comparing the scale of the Universal Time (TU), which is determined by the earths rotation, with any other more regular time scale. (2) Determination of the scale of atomic time. The scale of atomic time (TA) is based on the mean atomic standard which is obtained by way of averaging the readings (integrated frequencies) of the atomic standards of the worlds specific

laboratories. (3) Determination of the scale for the International Time. The scales of International Time (TI) are deduced from the astronomical determination of time, which are carried out at a number of special observatories, the Time services. Author (TAB)

N68-23649*# California Univ., Berkeley. Space Sciences Lab.
THE PRESENT DAY VIEW OF THE PHYSICAL UNIVERSE
Harold F. Weaver *In its* Ann. Conf. of Episcopal Cathedral Deans 10 Apr. 1967 p 79–101 (See N68-23643 13-34)

A general survey is made of the universe including the moon, Jupiter and Saturn, the Milky Way, the constellation Orion, Pleiades, other star clusters, the Crab Nebula, and several galaxies. The characteristics of these systems and their stars are described. A view of the universe using the radio spectrum is described. A brief mention is made of quasars. Several photographs accompany the discussion. R.N.A.

N68-23664 Kodaikanal Observatory (India).
THE SPECTRUM OF COMET IKEYA–SEKI (1965F)
M. K. V. Bappu and K. R. Sivaraman 1967 8 p *Its* Bull. No. 178, Ser. A

Spectroscopic observations of Comet Ikeya–Seki with slit and slitless instruments are described. Sodium emission in the coma is seen from October 9 to November 1. A sodium tail extending up to 2° from the nucleus was seen. Author

N68-23766# Centre National de la Recherche Scientifique, Paris (France).
SPECTROPHOTOMETRIC STUDY OF 1967 SUPERNOVA APPEARING IN NGC 3389 [ETUDE SPECTROPHOTOMETRIQUE DE LA SUPERNOVA APPARUE EN 1967 DANS NGC 3389]
Yvette Andrillat [1967] 7 p refs In FRENCH Reprinted Publ. de l'Observatoire de Haute Provence, Vol. 9, No. 14
CFSTI: HC $3.00/MF $0.65

Spectra of the Chaudze-Lovas supernova discovered in 1967 in the NGC 3389 region showed large brilliant bands separated by minima that are more or less characteristic of type I supernovae. Spectrophotometric study of the spectral energy distribution confirms a very weak emission in the ultraviolet appearing in type I supernovae. Transl. by M.W.R.

N68-23767# Centre National de la Recherche Scientifique, Paris (France).
ABUNDANCE DETERMINATION OF T BOOTIS, A METAL-RICH STAR, AND SOME REMARKS ON THE ABUNDANCES OF SOLAR TYPE STARS [DETERMINATION DES ABONDANCES D'UNE ETOILE RICHE EN METAUX "T BOOTIS" ET QUELOQUES REMARQUES SUR LES ABONDANCES DES ETOILES DE TYPE SOLAIRE]
Monique Spite-Lebon [1967] 6 p refs In FRENCH Reprinted Publ. de l'Observatoire de Haute Provence, Vol. 9, No. 22

Elemental abundances are given for a metal-rich, solar-type star Tau Bootis; and metallic and calcium abundances are given for 10 solar-type stars. Of these, two were rich in metals, four were classified as normal, and five were deficient in metallic content. The metallic-rich stars were found to be rich in calcium. Transl. by M.W.R.

N68-23770# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
UNITED STATES SPACE SCIENCE PROGRAM. REPORT TO COSPAR
1967 244 p refs Presented at 10th Meeting, London, Jul. 1967

Organization of space research and related activities in the United States is described, including responsibility for the national program as well as data exchange and international cooperative programs at NASA. Research on space vehicles during 1966 and projections for 1967 and 1968 activities are presented under the headings of astronomy, solar physics, particles and magnetic fields, upper atmospheric physics, and meteorology. Other areas are the moon, planets, and meteorites; life sciences; and satellite tracking, geodesy, navigation, terrain photography, and earth resources survey. Communications and applications technology satellites, sounding rocketry, and balloon technology are discussed; and ground-based and theoretical space research in 1966 are summarized. A listing of satellite and rocket launchings in 1966 and planned launchings in 1967 are presented; and an extensive bibliography of individual papers and conference proceedings during 1966 is included under 14 general categories that reflect both theoretical and flight efforts. M.W.R.

N68-23876# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE ELEMENTS OF SATELLITE ORBIT BY POSITION AND SPEED
Milan Bursa 13 Sep. 1967 17 p refs Transl. into ENGLISH from Studia Geophys. Geodaet., Ceskoslov. Akad. Ved. (Prague), vol. 10, no. 4, 1966 p 401–410
(FTD-MT-24-183-67; AD-667851)

In satellite geodesy it is assumed that the geocentric elements of a satellites orbit which define the position of the satellite are known at the precise moment in time that the observation is made. Orbital elements can be determined with the required degree of accuracy only if the observed topocentric quantities can be reduced accurately to geocentric values. This reduction requires that the position of the satellite station be known with respect to the earths center of mass. This is not known, however, and its determination is one of the principal problems in modern geodesy. The present paper analyzes the inaccuracies involved in correcting for parallax in the case of orbital elements computed from one position (three coordinates) and three velocity components. Relations are derived which express the exact geocentric elements. The derived relations are then compared with classical celestial mechanics formulas, taking into account those parameters which define the position of the origin and the direction of the axis of the reference surface used. TAB

N68-23878# Lund Univ. (Sweden).
COMPUTATIONS ON INTERSTELLAR EXTINCTION
Kenneth Borg 1967 33 p refs Presented at the Royal Physiographic Soc., 16 Dec. 1967 *Its* Ser. 2, No. 29
CFSTI: HC $3.00/MF $0.65

Theoretical extinction curves have been derived for spherical metal and graphite particles. The extinction values of iron, and more so of nickel, are too low in the infrared to account for the extinction observed in different regions of the Milky Way. Graphite, with dielectric behavior, can explain an observed depression in the extinction between the wavenumbers $1.6\mu^{-1}$ and $2.0\mu^{-1}$. The albedo for iron and nickel are high enough to explain the extinction, if the radii are about 0.05μ. Author

N68-23928# Lund Observatory (Sweden).
ON THE INTERPRETATION OF MEASUREMENTS WITH A SOLAR MAGNETOGRAPH
Jan Olof Stenflo 1968 32 p refs Presented at the Royal Physiographic Soc., 11 Jan. 1968 *Its* Ser. 2, No. 2
CFSTI: HC $3.00/MF $0.65

Measurements with a solar magnetograph are influenced in various ways by inhomogeneities in the solar atmosphere. If a large part of the Sun's magnetic field is concentrated in narrow filaments the observed value of the mean field may be much too low. It is shown that if the microspots occupy 1 percent or more of the solar surface, the effect is considerable and the observed field may be wrong by more than a factor of 2. The observed value of the average field may also be too low if the magnetic field is concentrated at the boundaries of convection cells. When the resolving power is increased, more Doppler shifts of the spectral line may be compensated for by the radial velocity compensator. The

Zeeman effect for a turbulent magnetic field in the photosphere is treated using some simplifying assumptions. All magnetic field in the photosphere is treated using some simplifying assumptions. All magnetic elements are assumed to be optically thin, i.e. $\leq$100 km (magnetic microturbulence). A weak, homogeneous field, H_m is superposed on a strong, locally isotropic turbulent field H_t. It is found that the observed mean field will be substantially smaller than H_m only if H_t is stronger than about 700 gauss. Author

N68-23953# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
A NOTE ON STAR-FREE EVENTS
Albert R. Meyer Feb. 1968 15 p refs
(Contract ARPA SD-146)
(AFOSR-68-0632; AD-667208)

A short proof of the equivalence of star-free and group-free regular events is possible if one is willing to appeal to the Krohn-Rhodes machine decomposition theorem. Author (TAB)

N68-23955# RAND Corp., Santa Monica, Calif.
CRUCIAL TESTS OF THE EXISTENCE OF A SOLAR QUADRUPOLE MOMENT
J. J. Gilvarry Mar. 1968 7 p refs
(P-3816; AD-667531)

Recently, Audretsch, Dehnen, and Honl (1967) have proposed what they state to be a crucial test of the solar oblateness hypothesized theoretically by Dicke (1964) and inferred observationally by Dicke and Goldenberg (1967). The purpose of this Letter is to show that the observation in question does not represent a crucial test, in fact, since it actually yields a result falling within the limits permitted by the corresponding residual. Author (TAB)

N68-23977# Lund Observatory (Sweden).
INVESTIGATIONS OF A REGION IN MONOCEROS. 2. DETERMINATION OF COLOUR EQUIVALENTS AND OF THE K LINE DEPTH FOR B, A, AND F TYPE STARS
Bengt Karlsson 1967 13 p refs Conf. Presented at the Royal Physiographic Soc., 29 Aug. 1967 *Its* Ser. 2, No. 22
CFSTI: HC $3.00/MF $0.65

Two color equivalents and the K line depth have been determined for about 800 early type stars in a region in Monoceros with the equatorial coordinates (1950.0) $\alpha = 6^h34^m$, $\delta = +9°$ ($l^{II} = 203°$, $b^{II} = +2°$). From the color equivalents a measure of the Balmer jump has been computed. The limiting magnitude corresponds to $B = 12^m$ to $12^m.5$. The data will be given in a subsequent paper. Author

N68-23998*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTRINSIC MAGNETIC PROPERTIES OF THE LUNAR BODY
Kenneth W. Behannon May 1968 38 p refs
(NASA-TM-X-63206; X-616-68-171) CFSTI: HC $3.00/MF $0.65
CSCL 03B

Preliminary analysis of magnetic measurements by Explorer 35 in lunar orbit suggested an upper limit of 4×10^{20} gauss-cm^3 for the magnetic moment of the moon. A more detailed analysis of a larger body of Explorer 35 data from measurements in the earth's magnetic tail has subsequently been performed. Reversal of the ambient tail field by 180° when the moon and spacecraft traverse the neutral sheet permits a separation of permanent and induced field contributions to the total field observed near the moon. When compared to calculated permanent and induced field effects, the results of this analysis lead to new upper limits of 10^{20} gauss-cm^3 on the lunar magnetic moment and 4γ on the lunar surface field. Limiting the moment induced in the moon by the magnetotail field permits an upper limit of 1.8 to be set on the bulk relative magnetic permeability of the moon. Author

N68-24006# European Space Data Centre, Darmstadt (West Germany).
THE DIFFERENTIAL CORRECTION OF CLOSE-EARTH SATELLITE ORBITS. PART 1: THEORY AND PRINCIPLES
H. G. Walter and I. M. Wales Paris ESRO Oct. 1967 80 p refs
(ESRO-SR-7(ESDAC)) CFSTI: HC $3.00/MF $0.65

A precise knowledge of the orbital parameters is a prerequisite for the determination of the position of a satellite. Owing to a variety of forces exercised upon a satellite, the orbital parameters are subject to change with time. Some of these forces are inadequately known and hence the theoretical methods for orbit determination are insufficient. A way out of this dilemma leads via the satellite observations to the updating of the orbital parameters. The method of achieving this updating is a differential correction procedure based on the observed and computed positions, to which a least squares method is applied. The first part of the report is devoted to an exposition of the basic theory for close-earth satellites. The second part gives details of the operation of the program and of the program structure. The orbital theory adopted follows essentially that of Y. Kozai for oblateness perturbations and makes allowances for the calculation of drag perturbations and lunar-solid perturbations. Various types of observations can be processed simultaneously by applying proper weighting factors to the components of the fixes. Author (ESRO)

N68-24024# Lund Observatory (Sweden).
THE PHOTOMETRIC CENTRE CORRECTION OF THE METCALF REFRACTOR AT THE BOYDEN OBSERVATORY
Kjell Johansson and Ulf Lindoff 1968 2 p ref Submitted for publication
CFSTI: HC $3.00/MF $0.65

The photometric center correction was determined for the 10" metcalf refractor of the Boyden Observatory. The result indicates that in the outer part of the plates the stars are about $0^m.1$ fainter than in the central part. Author

N68-24025# Lund Observatory (Sweden).
THE OPEN CLUSTERS TR 22 AND HO 17
Ulf Lindoff Stockholm Almqvist and Wiksell 1968 11 p refs Submitted for publication
CFSTI: HC $3.00/MF $0.65

Photographic magnitudes on the UBV-system and based on a photoelectric sequence were determined for stars in the open clusters Tr 22 and Ho 17. Spectral classes were determined for the brighter stars. The color excess is $0^m.53$ for Tr 22 and $0^m.54$ for Ho 17. The distances are 1700 pc and 1660 pc, respectively. Ho 17, although containing very few stars, seems to be a real cluster. Author

N68-24026# Lund Observatory (Sweden).
THE OPEN CLUSTERS NGC 5617, LY 2, AND TR 12
Ulf Lindoff Stockholm Almqvist and Wiksell 1968 21 p refs Submitted for publication
CFSTI: HC $3.00/MF $0.65

Photographic magnitudes were determined in the UBV-system for the southern open clusters NGC 5617, Ly 2, and Tr 12. The color excesses are $0^m.53$ (irregular) for NGC 5617 and $0^m.19$ for Ly 2. The distances are 1150 pc and 1100 pc, repsectively. Tr 12 is probably no real cluster. Author

N68-24085*# Analytical Mechanics Associates, Westbury, N. Y.
PERTURBING FORCES IN THE LUNAR GRAVITATIONAL POTENTIAL, PART 3 Final Report
George A. Austin and Paul F. Flanagen (NASA Manned Spacecraft Center, Houston, Tex.) Apr. 1968 15 p
(Contract NAS9-4036)
(NASA-CR-92125; Rept.-68-6) CFSTI: $3.00 CSCL 22C

To integrate the equations of motion of a lunar satellite, the perturbing forces due to the nonsymmetric mass distribution of the moon must be evaluated. The formulation needed to consider these perturbing forces is an expansion in spherical harmonics which permits the inclusion of a variable number of terms in the potential function. The values are interim results and are subject to modification. These constants will be used for the initial checkout of the real-time program with Lunar Orbiter I data since test cases from the JPL orbit determination program using these same constants are available. Author

N68-24092# Technische Univ., Berlin (West Germany). Institut fuer Raumfahrttechnik.

DESIGN CRITERIA FOR LARGE REUSABLE SPACE TRANSPORTATION SYSTEMS [ENTWURFSKRITERIEN FUER GROSSE WIEDERVERWENDBARE TRAEGERSYSTEME]

H. H. Koelle Jan. 1968 140 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBW-68-07) CFSTI: HC $3.00/MF $0.65

Criteria are developed for an unconventional, large, reusable ballistic space transportation system. The concept of "controlled simplicity" as well as market analysis and a system cost model are used to derive suitable system characteristics. A two stage rocket called Neptune is designed conceptually and used as a point of reference. This rocket promises to transport 400,000 kg payloads into orbit for less than 80 kg in the 1980s. This is approximately 1/20 of the corresponding value expected for the Saturn V rocket during the 1970s. The report contains design details on the structure, propulsion, flight performance, aerothermodynamics, and costs. Author

N68-24119# Technische Hochschule Munchen (West Germany). Institut fuer Astronomische und Physikalische Geodaesie.

ORBIT DETERMINATION BY MEANS OF RECURRENCE FORMULAE [BAHNBESTIMMUNG MITTELS REKURSIVER LOESUNGSDARSTELLUNG]

Manfred Schneider Jan. 1968 35 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBW-68-08; Rept.-46) CFSTI: HC $3.00/MF $0.65

Orbit determination is considered a boundary-value problem. To solve it, the motion is represented by a power series expansion, the coefficients being determined by recursive functions from initial conditions. The initial velocity is fixed through the second boundary-value. The procedure is illustrated by three examples. A general method of orbit determination is developed by combining the above method with another one previously published by the author; it is of interest in satellite geodesy because it allows the determination of field parameters and corrections of station coordinates. An interesting feature is the lack of principal indeterminateness. The method is not tied to a special representation of the gravitational field. Author

N68-24133# European Space Data Centre, Darmstadt (West Germany).

A RECURSIVE FORMULATION TO CALCULATE A SATELLITE'S MOTION ABOUT AN AXIALLY-SYMMETRIC PLANET

H. A. Kellner Paris ESRO Nov. 1967 15 p refs
(ESRO-SN-74(ESDAC)) CFSTI: HC $3.00/MF $0.65

The satellite's motion under the J12B perturbation is considered. At t = 0 the position and an appropriate set of local invariants are expanded formally as power series in t. Recurrence formulae are given to transform the instantaneous position-velocity vector into that at a time interval of GDT later. Author (ESRO)

N68-24172 RAND Corp., Santa Monica, Calif.

NONLINEAR RESONANCES NEAR THE EARTH-MOON EQUILATERAL LIBRATION POINTS

Hans B. Schechter Mar. 1968 121 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5315-PR; AD-667184)

An application of Hamiltonian mechanics to the three-dimensional nonlinear stability analysis of a body at the libration points L4 and L5 about 245,000 miles from both the Earth and the Moon, in the presence of the solar field. The objective was to determine if any stable periodic orbits are possible at either point. Contrary to the prediction of classical linear stability analysis disregarding the effect of the Sun, one stable equilibrium solution is found: a clockwise coplanar elliptic orbit around L4 with a major axis about 120,000 miles long oriented at right angles to the line from Earth to L4. Author (TAB)

N68-24176# European Space Data Centre, Darmstadt (West Germany).

OBSCURATION OF A SATELLITE TELESCOPE BY A SPHERICAL CELESTIAL BODY

K. G. Lenhart Paris ESRO Oct. 1967 15 p
(ESRO-SN-73(ESDAC)) CFSTI: HC $3.00/MF $0.65

The percentage of a solid angle which is covered partially, completely or not at all by sphere is calculated. The method is especially useful for fast calculation of obscuration of a satellite telescope by the earth. A computer program (FORTRAN IV) which performs exactly these calculations has been written. Author (ESRO)

N68-24179# Sandia Corp., Albuquerque, N. Mex.

AUTOROTATIONAL CHARACTERISTICS OF FLAT PLATES AND RIGHT CIRCULAR CYLINDERS AT SUBSONIC SPEEDS

A. C. Bustamante and G. W. Stone, Jr. Nov. 1967 27 p Presented at the Conf. on Dyn. and Aerodyn. of Bomblets, Eglin AFB, Fla.
(SC-RR-67-778)

Studies were conducted to investigate the free-flight motion of flat plates and right circular cylinders at subsonic speeds. For these studies, a new technique was developed for calculating dynamic stability derivatives. Author (NSA)

N68-24180* California Univ., Berkeley.

THE MEASUREMENT OF ROCK DEFORMABILITY IN BORE HOLES ON EARTH. ADAPTABILITY TO A LUNAR EXPLORATION PROGRAM

Richard E. Goodman, Tran K. Van, and Francoise E. Heuze Huntsville, Ala. NASA Marshall Space Flight Center Feb. 1968 51 p refs
(Contract NSR-05-003-189)
(NASA-CR-61202) CFSTI: $3.00 CSCL 22A

Devices for measuring rock deformability in bore holes are reviewed. They include: dilatometers, which supply an all around radial pressure to the whole of the bore hole wall; bore hold jacks, which supply a unidirectional, self-equilibrating pair of forces to opposed sectors of the wall; and penetrometers, which force a rigid die into a small portion of the wall. These devices are reviewed, and an NX bore hole plate bearing device, a new bore hole jack developed by the authors, is described. For interpretation of dilatometer data, a simple well-known relation gives E, Young's modulus, in terms of the diametral formation corresponding to each increment of pressure. An expression giving E for bore hole jacks is derived in this paper, and the influence of rock and jack characteristics on data interpretation is analyzed. Author

N68-24182# American Meteorological Society, Boston, Mass.

THE SOLAR WIND AND INTERPLANETARY MAGNETIC FIELDS [SOLNECHNYI VETER I MEZHPLANETNYE MAGNITNYE POLIA]

E. R. Mustel' Bedford, Mass. AFCRL Jan. 1968 27 p refs Transl. into ENGLISH from Priroda (USSR), no. 7, 1967 p 13-23
(Contract AF 19(628)-3880)
(T-R-678; AD-667420)

The report discusses recent findings concerning the causes and distribution of the interplanetary magnetic fields, and its relation to the solar wind. TAB

N68-24193*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCEEDINGS OF THE JPL SEMINAR ON UNCERTAINTIES IN THE LUNAR EPHEMERIS
J. Derral Mulholland, ed. 1 May 1968 44 p refs Held at Pasadena, 20 Jul. 1967 Proc. held at Pasadena, Calif., 20 Jul. 1967
(Contract NAS7-100)
(NASA-CR-94618; JPL-TR-32-1247) CFSTI: $3.00 CSCL 03B

The use of both optical and radar data as a combined base for computing the lunar ephemeris is projected in order to erase uncertainties in the lunar ephemeris. Studies presented during this conference centered on the lunar theory as well as on research affected by the ephemeris and which might be expected to verify corrections already made to it or point to corrections yet required. G.G.

N68-24195* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ELECTRIC FIELDS IN SPACE AND ON LUNAR SURFACE
William I. Linlor 1968 5 p refs Presented at 4th Intern. Conf. on the Universal Aspects of Atmospheric Elec., Tokyo, 12–18 May 1968
(NASA-TM-X-61094) CFSTI: $3.00 CSCL 03B

The use of a cesium ion beam in electric field measuring devices during space travel is evaluated. It is shown that such an instrument could measure electric fields of about 10^{-2} volts/meter. The projected ion beam source assembly consists of a cesium reservoir, protected by blow-off plate seal and argon blanket gas, a heater for temperature control, an ionizing surface with heater, accelerating electrodes, and a focusing lens. The beam requires about 5 micrograms cesium for a year of continual operation and its deflection gives an indication of the measured electric field strength. G.G.

N68-24196*# California Univ., Berkeley.
INVESTIGATION OF ROCK BEHAVIOR AND STRENGTH IN SITU AND LABORATORY TECHNIQUES ADAPTABILITY TO A LUNAR EXPLORATION PROGRAM
F. E. Heuze and R. E. Goodman Huntsville, Ala. NASA Marshall Space Flight Center Feb. 1968 23 p refs
(Contract NSR-05-003-189)
(NASA-CR-61201) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Discussed are rock testing techniques for on-site as well as for lunar samples returned to earth. In situ testing methods include: (1) seismic wave velocity measurements from refracting waves caused by surface impact, seismic recordings on up-hole shooting and continuous logging in drill hole or cross hole; and (2) static testing of behavior and strength parameters of rock mass through elastic and permanent rock deformation measuring instruments. Laboratory testing procedures include: nondestructive dynamic testing techniques as pulse velocity, and resonance measurements and static testing techniques comprising compression, shear, tension, creep, and permeability measurements on the samples. G.G.

N68-24331# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DE-ORBITING OF SATELLITES ALONG SPECIFIED BALLISTIC TRAJECTORIES
J. E. Avery [1967] 24 p refs
(Doc.-67SD252)

An analysis and desk-side computer system (DSCS) computer program to compute parameters for de-orbiting a satellite, or portion of a satellite, from some circular orbit, along a trajectory simulating that of some specified ballistic missile. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-23294# ARO, Inc., Arnold Air Force Station, Tenn.
POSTFLIGHT (AS-202) APOLLO COMMAND MODULE AERODYNAMIC SIMULATION TESTS Final Report, Dec. 1966–May 1967
B. J. Griffith and D. E. Boylan Arnold Eng. Develop. Center Mar. 1968 113 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-238; AD-666927)

A comprehensive postflight wind tunnel investigation of the Apollo Command Module was conducted to resolve several anomalies between flight (AS-202) and preflight aerodynamic data. Attention was focused on (1) simulating the actual vehicle as flown, (2) obtaining consistent pitch plane force measurements in the angle-of-attack range 150 < or = alpha < or = 180 deg, (3) the effect of Mach number over a range of 3 to 20, (4) the effect of Reynolds number, and (5) possible sting effects. Results indicated that prior failure to duplicate the asymmetrical wavy heat shield in preflight testing resulted in a significant error in trim angle-of-attack prediction. In addition, a strong viscous influence was found to extend down to an altitude of about 220,000 ft. Also, a Mach number influence to a value of about 14 was found which is substantially higher than previous blunt body investigations have indicated. Author (TAB)

N68-23326* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BIOSATELLITE 2 EXPERIMENT ENVIRONMENT
Bonne C. Look 24 Feb. 1968 14 p Presented at NAS Symp., Washington, D.C., 23–24 Feb. 1968
(NASA-TM-X-61080) CFSTI: $3.00 CSCL 22B

The reentry vehicle of the Biosatellite 2 spacecraft is described, along with the environment required for conducting the experiments carried in the vehicle, which consisted of the experiment capsule, the heat shield, and the thrust cone or retro rocket assembly. Experiment packages were made of polypropylene or Lexan and had brackets and supports of aluminum; and one or more LiF powder radiation dosimeters and thermistors were located inside or attached to each package. The earth's sea level atmosphere was maintained in the experiment capsule; and samples of the atmosphere were taken prior to final capsule closure before launch and before opening the capsule after recovery. Mention is made of radiation, acceleration, vibration, shock and noise environments for the capsule; and of the ground control tests conducted during the flight. It is noted that the Biosatellite spacecraft provided a laboratory suitable for conducting biological experiments in the space environment experienced by a near earth orbiting satellite, and that all the biological specimens were retrieved in excellent condition. M.W.R.

N68-23400*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BIOSATELLITE 2 MISSION
Charles A. Wilson 24 Feb. 1968 8 p Presented at NAS Symp., Washington, D. C., 23–24 Feb. 1968
(NASA-TM-X-61076) CSCL 22B

Described is the preparation and actual operational flight phase of a 960 pound spacecraft biological laboratory that contained thirteen selected general biological and radiation experiments that

were subjected to carefully controlled environmental conditions during 45 hours of Earth orbital flight. A secondary objective of the mission was a successful demonstration of restart and second burn capability for the spacecraft after spacecraft–booster separation. The operational phase of the mission came to conclusion with the deorbit of the recovery capsule, deployment of the parachute system, and air recovery of the capsule. Immediate visual inspection of the biological materials found a special leaf orientation of the pepper plant. The quality of the returned biological specimens was excellent. G.G.

N68-23401* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BIOSATELLITE 2 OPERATIONS
John W. Dyer 24 Feb. 1968 17 p Presented at NAS Symp., Washington, D.C., 23–24 Feb. 1968
(NASA-TM-X-61078) CFSTI: $3.00 CSCL 22B

Described are preparation, launch, and recovery procedures for a 950 pound biological spacecraft launched by a Delta vehicle and carrying various biological experiments in a 285-pound capsule. The spacecraft orbited successfully for 30 orbits when weather disturbances caused the implementation of the deorbiting phase. Recovery procedures were controlled by computers and were uneventful; the capsule was safely recovered and shipped to the biological receiving section for content evaluation. G.G.

N68-23421 Rensselaer Polytechnic Inst., Troy, N. Y.
DESIGN OF AN ATTITUDE CONTROL SYSTEM FOR A LARGE SPACE VEHICLE
Edward John Smith (Ph.D. Thesis) 1966 299 p
Available from Univ. Microfilms: HC $13.50/MF $3.85 Order No. 67-4197

This research is concerned with the investigation of the large angle behaviour of the attitude of a space vehicle under the control of a nonlinear attitude control system. The attitude orientation is controlled by an on-off control system which contains a deadband. The large attitude angle excursion problem occurs during the injection into orbital flight when the acquisition of a unique attitude is desired, during rendezvous and docking maneuvers, during entry and reentry or atmospheric flight and during liftoff from the surface of alien planets. It represents an important but relatively unexplored area of investigation. An interplanetary flight was chosen for the synthesis of the control system. This type of mission contains all of the elements of the large excursion problem and offers a basis for the establishment of the closed loop system performance criterion. Dissert. Abstr.

N68-23422 Auburn Univ., Ala.
AN ACCELERATION VECTOR ATTITUDE CONTROL SYSTEM
Sherman Martin Seltzer (Ph.D. Thesis) 1966 197 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-4683

The purpose of this investigation is to determine a control scheme which will minimize lateral drift and concurrently maintain the structural load limits of the vehicle. The proposed control scheme selects the quantity to be controlled by a philosophy different from that of extant methods. The proposed scheme attempts to make the actual acceleration vector colinear with the one desired. Time-varying system parameters are assumed constant, thereby permitting the analytical determination, through Laplace transform methods, of responses to various expected forcing function step inputs. The proposed scheme more effectively solves the problem of vehicle lateral drift under the constraint of not exceeding structural limits than does the representative contemporary control schemes. Simulated flight results from a digital computer are then compared, using time-varying system parameters, and again the proposed scheme produces better lateral drift characteristics. Dissert. Abstr.

N68-23588*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM. PAYLOAD INTEGRATION Program Report, Second Contract Period
13 Apr. 1967 167 p refs
(Contract NAS8-21004)
(NASA-CR-61762; PR-2003-3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Technical and management studies are presented which were conducted to define the Apollo Applications Program (AAP) payload integration tasks. Technical studies associated with the cluster mission were emphasized and included orbital workshop activation, thermal control, stabilization and pointing, electrical networks, mission operations, crew operations, test requirements, dynamic loads, ground support equipment, and communications. Also investigated were such operational aspects as facility activation, manufacturing, and quality to determine special requirements for payload integration. The feasibility of combining several groups of experiments from other spacecraft was examined. In addition to the cluster and its flights, the other missions in the AAP were studied, particularly the synchronous orbit missions. Program and business management studies, an event network, and a milestone chart are included in this report. K.W.

N68-23669*# Aeronutronic, Newport Beach, Calif.
STUDY OF A PASSIVE DAMPER FOR ATMOSPHERIC ENTRY BODIES Final Report
Richard R. Auelmann, Andrew B. Bauer, Richard A. DuPuis, and Joyce M. Roberts 18 Apr. 1966 211 p refs
(Contract NAS2-3274)
(NASA-CR-94580; U-3548) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The design and operation of a passive damper for use on spinning and nonspinning entry bodies are examined. The damper is a constant curvature tube which contains a high density ball and a fluid. Two such dampers are orthogonally mounted with respect to the vehicle centerline with the convex edges facing forward. Oscillations of the vehicle caused the balls to move in their tubes. The ball motions are opposed by the fluid, energy is dissipated, and the vehicle angle of attack is damped. The basic damper parameters are the mass, the tube radius of curvature, the location of the tube, the tube length, elasticity of the tube stops, and the fluid drag. All other factors being equal, the damper performance is limited by the available mass. The results given are for dampers which weigh between 5 and 10 percent of the vehicle weight. This suggests that passive dampers are not practical for vehicles which weigh in excess of 100 pounds, active systems being more competitive. Author

N68-23683*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION. DETERMINATION OF SIMULATOR REQUIREMENTS AND EVALUATION OF AN ALTERNATE TEST PROGRAM FOR AAP 1/2/3/4
J. Best and D. Lloyd 16 Jun. 1967 116 p
(Contract NAS8-21004)
(NASA-CR-61761; ED-2002-135) CFSTI: $3.00 CSCL 22B

A test program for Apollo Applications Programs 1/2 and 3/4 was evaluated without including cluster-type design verification testing; and gross simulation requirements were determined for the established test program. Simulator descriptions and carrier interfaces are considered; and simulator requirements are summarized for both flight test programs, which are found to be weak in many areas and considered to provide less than desirable confidence in on-orbit compatibility. In both test programs, the qualification and design verification of the individual flights 1/2 and 3/4 carriers appeared to be adequate. A full-flight configured prototype is recommended to facilitate a more adequate flight 1/2 test program and to establish a means of verifying compatibility between the elements of flight 1/2 and 3/4. Also recommended are mated

AM/MDA design compatibility testing using the flight configured prototypes and a mated LM Apollo spacecraft and Apollo telescope mount flight configured prototype test. M.W.R.

N68-23725* Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION. MISSION FEASIBILITY ANALYSIS, AAP UNASSIGNED MISSIONS. TECHNICAL STUDY AND ANALYSIS REPORT
29 Mar. 1967 225 p
(Contract NAS8-21004)
(NASA-CR-61760; ED-2002-59) CFSTI: $3.00 CSCL 22B

A feasibility analysis is made for a number of unassigned missions of the Apollo Applications Program (AAP), with consideration given to payload integration for low earth orbit, synchronous orbit, lunar landing or shelter, ground-outfitted workshop low earth orbit, and Voyager missions. Facilities and ground support equipment were considered along with the mission analyses in order to define system mismatches and major problem areas for missions beyond flight 4. Add-on modules for AAP subsystems are recommended which can compensate for the mismatches caused by payload integration experiments and other requirements of the AAP carriers. A summary of the analyzed missions is included for the performance parameter of weight; and methods of analysis and ground rules are detailed. M.W.R.

N68-23888*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION. GENERAL DESIGN PLAN. Technical Study and Analysis Report
7 Apr. 1967 61 p
(Contract NAS8-21004)
(NASA-CR-61759; PL-2002) CFSTI: $3.00 CSCL 22B

Identified are those design tasks necessary to implement the Apollo applications program. General design criteria for each AAP flight are established and those design tasks that are common to each of the mission flights are listed for use in hardware selection and human engineering planning. Experiments, experimental groupings, and individual flight profiles are reviewed and integrated with space vehicles and supporting subsystems into a coordinated space system. G.G.

N68-23889*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
ATS POWER SUBSYSTEM RADIATION EFFECTS STUDY, PHASE 1 Final Report
W. D. Brown Feb. 1968 127 p refs
(Contract NAS5-3823)
(NASA-CR-94612; SSD-80089R) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Available flight data for six synchronous satellites and for the special ATS solar cell experiment were analyzed in an effort to identify the damage mechanism that resulted in the anomalous degradation of the solar cell arrays. Since all degradations exhibited a logarithmic time dependence, it was assumed that radiation effects were the basic cause. A laboratory irradiation test program with proton energies and fluences comparable to those expected in a synchronous orbit established low energy proton damage as the primary damage mechanism responsible for performance degradation. Cross correlation of the various data identified the degradation source as transmission loss in the coverslide assemblies and it was concluded that the aft panel and the solar cell experiment mounted on the aft panel, were contaminated with some substance that darkened with time under ultraviolet (UV) and/or low energy proton exposure. G.G.

N68-24135# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
RECOVERABLE SOUNDING ROCKET. PARAGLIDER-VERSION [RUECKFUEHRBARE HOEHENFORSCHUNGSRAKETE. PARAGLEITER-VERSION]
H. Haeuser Jan. 1968 77 p In GERMAN; ENGLISH summary
Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBW-68-06) CFSTI: HC $3.00/MF $0.65

This report presents a comprehensive description of the first part of the planning and developments for a recovery-controlled sounding rocket to prepare the flight testing of a paraglider recovery system in the transonic and supersonic speed range: state of development May 1967. Author

N68-24338*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATLAS–CENTAUR FLIGHT PERFORMANCE FOR SURVEYOR MISSION A
Washington May 1968 148 p refs
(NASA-TN-D-4580) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The first operational Atlas–Centaur launch vehicle AC-10, with Surveyor spacecraft SC-1, was launched May 30, 1966. Surveyor was the first earth-launched spacecraft to soft land, under controlled conditions, on the lunar surface. Landing on the lunar surface occurred on June 2, 1966. This report includes a flight performance evaluation of the Atlas–Centaur launch vehicle systems from lift-off through spacecraft separation and Centaur retromaneuver. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-23088 Pittsburgh Univ., Pa.
THE DYNAMICS OF MULTIPLE BODY SYSTEMS
Thomas Anthony Sherby (Ph.D. Thesis) 1966 189 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-4147

Recurrence formulae are developed which give the m^{th} order absolute derivative of a vector which is resolved in a reference frame U_n which is moving relative to another reference frame U_{n-1}, which in turn is moving relative to another, etc., such that any number of moving reference frames may be involved. Using these formulae, the general equations of motion for a system of multiple rigid bodies are derived in terms of the relative motions of the rigid bodies. A MAD computer program is presented which calculates the first, second and third derivatives of a vector in a system involving up to seventeen reference frames. The equations of motion for multiple body systems which was developed are applied to two problems in space flight dynamics. Dissert. Abstr.

N68-23089 Texas A&M Univ., College Station.
ANALYSIS OF STRUCTURALLY AND INTRINSICALLY ORTHOTROPIC SHELLS OF REVOLUTION BY THE MATRIX DISPLACEMENT METHOD
Danny Reynolds Tidwell (Ph.D. Thesis) 1966 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-4726

This research is concerned with the development of a general analysis of structurally and intrinsically orthotropic thin shells of

revolution with either axisymmetric or asymmetric loading. The formulation is based on the matrix displacement method. Series of curved orthotropic elements, jointed at nodal circles, are used to idealize the shell. The slope of the curved element is represented by a second degree polynomial in the meridional distance. Both meridional and circumferential rib stiffeners are considered in the analysis. Results of analyses of several shell configurations are presented and compared with solutions by other methods. It is found that the method provides accurate solutions for shells of revolution under both axisymmetric and asymmetric loadings yet requires only a reasonable number of elements. Dissert. Abstr.

N68-23090 Northwestern Univ., Evanston, Ill.
ON THE DYNAMIC RESPONSE OF SUBMERGED PLATES AND SHELLS
James Edward Russell (Ph.D. Thesis) 1966 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-4266

Two methods for approximating the transient response of infinitely long, circular, cylindrical shells submerged in an acoustic medium are introduced. One approximation adds a correction term for dependence on the axial coordinate to the well-known cylindrical wave approximation. The other approximation makes use of the natural frequencies of the shell-fluid system. Ranges of applicability of both approximations are discussed and their validity verified by comparison with previously published exact results. The steady-state response of an infinite plate on an elastic foundation subjected to a step load moving with a constant speed is investigated. The response is shown to be highly dependent on the load speed and three velocity ranges are found. The solution for the submerged plate, using piston theory to approximate the radiated pressure, is presented and the approximation is shown to give good results for load speeds greater than about twice the sonic speed of the fluid. Dissert. Abstr.

N68-23100 Virginia Univ., Charlottesville.
DYNAMIC BEHAVIOR OF HYPERCRITICAL SHAFTS ON MANY ELASTIC SUPPORTS
Ayhan Cetiner (Ph.D. Thesis) 1966 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-3775

The steady state response of hypercritical shafts having translationally and rotationally resisting intermediate supports was analyzed to develop a technique to aid in understanding and studying the flexural vibration behavior of rotating shafts. Flexural vibrations are induced through the initial crookedness and mass unbalance distribution along the shaft axis. The shaft is flexibly supported on supports having translational and rotational mass-spring-damper units located along the shaft. The general solution of the differential equation of motion is obtained by considering each span of the shaft independently, and combining the solutions from neighboring spans by making use of the existing continuity conditions at intermediate support locations. Continuity conditions and boundary conditions are transformed into a set of matrix equations. A computer program is developed for the numerical analysis of the problem. Dissert. Abstr.

N68-23249 Northwestern Univ., Evanston, Ill.
ON THE ANALYSIS OF STRUCTURES WITH N-FOLD SYMMETRY
Robert Franklin Hart (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-4230

The hypothesis is made that a region of *n*-fold symmetry may be replaced with a ring made of a composite anisotropic material, provided *n* is sufficiently large. The nature of the anisotropy is such that transverse isotropy exists elastically, with the meridional plane being the plane of isotropy. The elastic constants are invariant upon a change of the space variables in a cylindrical coordinate system; a property which has been called cylindrical homogeneity. The governing equations for a state of plane stress are formulated for a ring having the stipulated homogeneity and anisotropy. An existing axisymmetrical finite element procedure is extended to admit the necessary concepts of *n*-fold symmetry and anisotropic properties. The finite element method is then applied to two of the many difficult three-dimensional problems which exist in industry. The first example is that of a commutator for a direct current motor. The second example is that of a gas turbine impeller. Dissert. Abstr.

N68-23270 Northwestern Univ., Evanston, Ill.
A GENERALIZED DYNAMICAL THEORY OF THERMOELASTICITY
Harold Wesley Lord (Ph.D. Thesis) 1966 132 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-4245

A generalized dynamical theory of thermoelasticity is formulated using a form of the transport equation which includes the time needed for acceleration of the heat flow. The theory takes into account the coupling effect between temperature and strain fluctuations and predicts a finite velocity of propagation for a thermal disturbance. The governing equations contain two parameters: the usual coupling constant which is a property of the medium and another constant which is related to the relaxation time of the mechanism by which thermal energy is carried in the material. The coupling between temperature and strain variations becomes negligible at temperatures near absolute zero, and the governing equations of the generalized theory reduce to those of the conventional coupled theory of thermoelasticity at higher temperatures (at room temperature for most materials). The theory is applied to the boundary-value problem of an initially quiescent elastic half-space subjected to a step-strain disturbance at its plane surface. Dissert. Abstr.

N68-23280# New York Univ., N. Y. Dept. of Mathematics.
NONLINEAR BOUNDARY VALUE PROBLEMS FOR THE CIRCULAR MEMBRANE
Andrew J. Callegari and Edward L. Reiss Feb. 1968 32 p
(Contracts N0014-67-A-0467; Nonr-285(42))
(IMM-365; AD-666961)

Existence and uniqueness theorems are proved for two boundary value problems for the axisymmetric deformation of a circular membrane subjected to normal pressure. The nonlinear Foppl membrane theory is employed. The shooting method is used to establish these results. It is also shown that if the edge is free to move in the plane of the membrane then a necessary and sufficient condition for the existence of a unique solution is that the pressure is self-equilibrating. The shooting method is applied to obtain a numerical solution of the fixed edge membrane with uniform normal pressure. Author (TAB)

N68-23307# Technion Research and Development Foundation, Ltd., Haifa (Israel). Aeronautical Engineering Dept.
THE INFLUENCE OF STIFFENER GEOMETRY AND SPACING ON THE BUCKLING OF AXIALLY COMPRESSED CYLINDRICAL AND CONICAL SHELLS
Josef Singer Oct. 1967 102 p refs
(Contract AF 61(052)-905)
(TAE-68; SR-3; AFOSR-68-0670; AD-666920)

An experimental and theoretical study of the buckling of closely stiffened cylindrical and conical shells under axial compression was undertaken to determine the influence of the stiffener geometry and spacing on the applicability of linear theory. Tests on integrally ring stiffened cylinders, in which the spacing, cross sectional area and eccentricity of the stiffeners is varied are described. The bounds of general instability are first determined by an elementary

analysis of sub-shells and panels between stiffeners, in conjunction with smeared stiffener theory, the interaction between stiffeners and shell is then investigated with a linear discrete stiffener theory. The experimental results are correlated with theory and approximate design criteria are developed. Experimental results and conclusions of other investigators are also discussed. The results of a test program of integrally ring stiffened conical shells are briefly discussed and correlated with the results obtained for cylindrical shells, the structural efficiency of closely stiffened cylindrical shells is then studied in view of the observed bounds of applicability of linear theory. Author (TAB)

N68-23311# Aeronautical Research Associates of Princeton, Inc., N. J.

EXCEEDANCES OF STRUCTURAL INTERACTION BOUNDARIES FOR RANDOM EXCITATION

John C. Houbolt Dec. 1967 14 p refs

(Contract AF 49(638)-1640)

(ARAP-113; AFOSR-68-0032; AD-666942)

A general theory is developed for determining the number of times a given structural interaction boundary is exceeded when the structure is under random excitation, one of the practical problems of concern is that of an airplane encountering a random gust field, where spar design is governed by interaction curves involving combined axial and shear stresses, based on a normal-type joint distribution curve, a fairly simple basic equation is developed which allows for the rapid evaluation of the number of exceedance of any stipulated interaction curve. The similarity of the equation with Rice's familiar equation for the single variable case is shown. The theory and results are also developed for cases which obey non-normal distribution laws of the type that are more likely to be found in practice, in addition, exact solutions are obtained for certain special cases of interest. Author (TAB)

N68-23336# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

COMPARATIVE STUDY OF OPTIMIZATION TECHNIQUES FOR SHOCK AND VIBRATION ISOLATION

D. C. Karnopp and A. K. Trikha Jan. 1968 44 p refs

(Contract AF 49(638)-1314)

(AFOSR-68-0242; AD-666928)

Several optimum and sub-optimum isolators are discussed with respect to three different criteria appropriate to shock and vibration isolation. In attempting to show the limitations of performance of a system optimized according to one criterion when considered from the point of view of another criterion, a number of advantages and disadvantages of the optimum systems are made evident. The results are presented in trade-off diagrams which allow a continuous range of choice in penalizing measures of relative displacement and force or acceleration of the isolated element. Author (TAB)

N68-23338# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.

STABILITY OF STRAIGHT BARS SUBJECTED TO REPEATED IMPULSIVE COMPRESSION

Dusan P. Krajcinovic and George Herrmann Dec. 1967 39 p refs

(Grant AF-AFOSR-100-67)

(TR-67-8; AFOSR-68-0003; AD-666921)

The problem of the parametric resonance of a straight bar subjected to a periodic impulsive axial compression is analyzed. With the aid of the Floquet theory the boundaries of the instability regions (unbounded transverse motions) are established. The general results are illustrated with several specific examples, including elastically supported and sandwich beams for various boundary conditions. The new results are qualitatively related to the cases of parametric resonance problems of corresponding beams studied previously. Author (TAB)

N68-23345# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

GENERALIZATION OF THE UNIT DISPLACEMENT THEOREM WITH APPLICATIONS TO STRUCTURAL DYNAMICS Final Report

Janusz S. Przemieniecki 10 Jul. 1967 33 p refs Presented at the AF Conf. on Matrix Methods of Struct. Analysis, Wright-Patterson AFB, Ohio, 27–28 Oct. 1964

(AFIT-TR-67-10; AD-663924)

The Unit Displacement Theorem is generalized to include inertia, thermal and distributed loading on continuous and discrete element structures. The theorem is then applied to determine structural stiffnesses, thermal and inertia properties of structures, and equivalent concentrated forces due to distributed loading. Exact expressions are derived for the calculation of frequency dependent stiffness and equivalent mass matrices used in structural vibrations analysis. To facilitate practical calculations, however, the exact expressions are expanded into a matrix series in ascending powers of the frequency. This in turn leads to the formulation of the modified equation of motion and the modified characteristic equation in which higher order terms are present. A criterion for the condition when the higher order terms may be neglected is suggested. The use of the equivalent mass matrices and the modified characteristic equation greatly enhances the accuracy of the calculated frequencies and mode shapes. The first two terms in the matrix series for the stiffness and equivalent mass matrices are derived for a uniform bar element. In addition, the first term for the equivalent mass matrix is derived for the following structural elements: torsion bars, beams, triangular and rectangular plates, solid tetrahedra, and solid parallelepipeds. A numerical example is included to illustrate the advantages of the equivalent mass matrices and the modified characteristic equation. Author (TAB)

N68-23351# Aerospace Corp., El Segundo, Calif. Lab. Operations.

A STUDY OF BUCKLING AND SNAPPING UNDER DYNAMIC LOAD, AUGUST 1966–AUGUST 1967

M. H. Lock Dec. 1967 53 p refs

(Contract F04695-67-C-0158)

(TR-0158(3240-30)-3; SAMSO-TR-68-100; AD-666914)

The behavior of a shallow arch and a thin ring under a dynamic pulse loading is studied for a wide range of geometric and load parameters. The nonlinear dynamic response and static load deflection characteristics of the systems are related and employed to define dynamic elastic snapping and dynamic elastic buckling. When such a relationship cannot be established, the mechanism of dynamic elastic-plastic buckling is introduced. Critical dynamic load criteria are specified, and critical dynamic load data are developed as a function of structural geometry and load duration. Finally, a classification scheme for dynamic load problems is suggested. Author (TAB)

N68-23355*# Lockheed Aircraft Corp., Sunnyvale, Calif.

BUCKLING OF SHELLS OF REVOLUTION WITH VARIOUS WALL CONSTRUCTIONS. VOLUME 3: USER'S MANUAL FOR BOSOR

D. Bushnell, B. O. Almroth, and L. H. Sobel Washington NASA May 1968 120 p refs

(Contract NAS1-6073)

(NASA-CR-1051; Rept.-4-17-67-4) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Presented is a comprehensive computer program for the analysis of shells of revolution with axisymmetric loading. The program includes nonlinear prebuckling effects and is very general with respect to geometry of meridian, shell wall design, edge conditions, and loading. Despite its generality the program is easy to use. Branches are provided such that for commonly occurring cases the input data involves only basic information such as geometrical and material properties. The computer program was verified by comparisons with other known solutions. Author

N68-23371*# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.

STRUCTURES 2: THE RESPONSE OF A CLAMPED CIRCULAR PLATE TO IMPULSIVE LOADS

R. E. Sennett and D. E. Skaar Oct. 1966 22 p refs

(Contract NAS9-3081)

(NASA-CR-92088; TR66-63) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A computer program describes the response of a clamped circular plate to an axisymmetric impulsive load. An explanation of its use, and a sample problem to illustrate the input and output data formats, as well as various output options, are included. Author

N68-23399*# IIT Research Inst., Chicago, Ill.

HIGH PERFORMANCE STRUCTURES

Ralph L. Barnett and Paul C. Hermann Washington NASA May 1968 124 p refs

(Contract NASr-65(16))

(NASA-CR-1038) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Materials selection, structural geometry development, prestressing, proof testing and statistical screening, and system energy were used as general design tools for studying optimum tension members, columns, and trusses. A design philosophy based on proof testing or statistical screening is introduced that turns the characteristic scatter in fracture and yield strengths into an asset by emphasizing the strong elements in a sample. Proof testing is considered to recast the performance aspects of brittle design into an economic framework. A statistical load redistribution for ductile tension members is proposed that takes size effect into account, and prestressing is used to eliminate local buckling in a tubular column. Two classical column designs were investigated which required the optimum longitudinal distribution of a specified total mass to prevent Euler buckling, energy-strength tradeoffs were considered, and the design of statically determinate trusses for minimum weight and deflection was studied. Optimum stiffness/weight beam, constant stress trusses, and end and triangular loaded cantilevers were investigated. M.W.R.

N68-23411# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.

FINITE EXPANSION OF A HOLE IN A RIGID-WORK HARDENING DISK OF INITIALLY NON-UNIFORM THICKNESS

S. Nemat-Nasser Mar. 1968 23 p refs

(Contract N00014-67-A-0109-0003)

(TR-17; AD-666831)

A complete analytical solution is developed for the problem of finite expansion of a circular hole of zero (pin-hole) or finite initial radius, using Trescas yield condition and the associated flow rule together with an isotropic strain-hardening law. Results of previous investigations are obtained as special cases of the present more general, closed-form solution. Author (TAB)

N68-23430# Aeronutronic, Newport Beach, Calif.

NONCONSERVATIVE BEHAVIOR OF COMPOSITE MATERIALS Annual Report, Jan. 1967–Jan. 1968

Joseph M. Bloom Wright-Patterson AFB, Ohio AFSC Jan. 1968 74 p refs

(Contract AF 33(615)-5198)

(U 4324; AFML-TR-68-10; AR-3; AD-666675)

The axial loading solution for anisotropic filaments is an extension of the isotropic filaments solution included in AD-654 056. Numerical results are presented indicating that stresses in the transverse plane are lower than for isotropic filaments and that the simple rule of mixtures approximations for predicting composite axial stiffness and major Poissons ratio are valid for anisotropic as well as isotropic filament composites. Experimental studies included the determination of longitudinal shear strength and stiffness properties of unidirectional boron-epoxy composites. The solid rod torsion test as well as the plate twist test were used. Tension-zero-tension cyclic fatigue data for 0 deg unidirectional S glass-epoxy composites are presented along with additional data concerning the influence of surface grinding on the mechanical properties of 90 deg unidirectional specimens. An analytical investigation of the linear viscoelastic behavior of composite materials is made by the solution of the problem of a single elastic inclusion in an infinite viscoelastic matrix under transverse loading. Experimental data presented in the literature is evaluated and used in various approximate viscoelastic models for the epoxy resin matrix. Insights into the behavior of the periodic array of inclusions are drawn from the single inclusion solution with limitations noted. Author (TAB)

N68-23451*# Lockheed Aircraft Corp., Sunnyvale, Calif.

BUCKLING OF SHELLS OF REVOLUTION WITH VARIOUS WALL CONSTRUCTIONS. VOLUME 2: BASIC EQUATIONS AND METHOD OF SOLUTION

D. Bushnell, B. O. Almroth, and L. H. Sobel Washington NASA May 1968 83 p refs

(Contract NAS1-6073)

(NASA-CR-1050; LAC-4-17-67-1, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Basic equations are formulated for the computer program used in prebuckling and stability analysis of the axisymmetric collapse and nonsymmetric bifurcation buckling behavior of cylinders, cones, and spherical and toroidal shell segments subjected to axial compressive loads. The method used in solving these equations is described. A set of more general stability equations is appended. E.J.S.

N68-23452*# General Dynamics Corp., San Diego, Calif.

DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 13: AERODYNAMIC MODEL TESTS FOR CONTROL PARAMETER DETERMINATION

David R. Lukens Washington NASA May 1968 26 p refs

(Contract NAS8-11486)

(NASA-CR-947; GD/C-BTD-67-112, V. 13) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Introductory data are presented on, and procedures recommended for, aerodynamic model testing of control parameters required in the design and analysis of spacecraft flight control systems. Items to be considered in planning, designing, and conducting a model test for the determination of aerodynamic forces and moments are discussed in terms of wind tunnel apparatus and facilities. Force and pressure testing techniques are described as well as commonly used procedures for control effectiveness testing. Captive and free flight models used in dynamic stability tests are described. E.J.S.

N68-23453*# General Dynamics Corp., San Diego, Calif.

DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 15: SHELL DYNAMICS WITH SPECIAL APPLICATIONS TO CONTROL PROBLEMS

L. E. Penzes Washington NASA May 1968 197 p refs

(Contract NAS8-11486)

(NASA-CR-949; GD/C-BTD-67-120) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The purpose of this monograph is to explain the foundations of thin-walled elastic shells and the basis of theoretical derivations. An attempt is made to fill the gap between the contents of dynamics textbooks and recently published literature and to explain the differences in their treatment of the subject. Examples and problems are given to demonstrate the use of the theories. Some static problems are discussed to compare them with equivalent dynamic problems. In addition, the applicability of shell vibration theory to missiles and launch vehicles is described. Attention is

focused on calculation of dynamic model parameters affecting stability and control. Emphasized are modes for which the system frequency falls within the bandwidth of the control system, i.e., below 20 Hz for a large space booster. K.W.

N68-23454*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 14: TESTING FOR BOOSTER PROPELLANT SLOSHING PARAMETERS
D. M. Eggleston Washington NASA May 1968 37 p refs
(Contract NAS8-11486)
(NASA-CR-948; GD/C-BTD-67-089, V. 14) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Summary data are presented on the state-of-the-art in booster propellant slosh testing and a mathematical model, defined as that set of differential and functional equations used to represent the forces and moments exerted on the vehicle due to the liquid propellants, is formulated. Known digital computer programs for generating parameters for a pendulum or spring-mass model of the basic fluid motion are reviewed, and together with known data and techniques, are organized for convenient use in new situations and for new launch vehicles. Recommendations are included for the establishment of test objectives and planning criteria, facility design and instrumentation, test operations and disturbance effects, and data reduction and scaling techniques. E.J.S.

N68-23486 Arizona Univ., Tucson.
CONTACT STRESSES BETWEEN FINITE TWO DIMENSIONAL ELASTIC BODIES
Dennis Oren Blackketter (Ph.D. Thesis) 1966 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-148

A method is presented for determining the contact stress distribution between two elastic bodies with general surface configurations. The bodies treated are nearly rectangular with surfaces which deviate from the rectangular shape by a small amount. The surface defining equation must be a continuous function of position. The slope of the surfaces must be small but need not be continuous. A procedure is presented for determining the optimum surface load and the optimum surface configuration for various conditions. The approximate method used involves a solution to the partial differential equations of elasticity for surface load expressed in terms of a trigonometric series. The coefficients of the trigonometric series are evaluated by enforcement of the appropriate constraint conditions. Optimum surface loads and surface configurations are presented for the shear stress theory of failure and for the energy of distortion theory of failure. Dissert. Abstr.

N68-23491 Texas A&M Univ., College Station.
STIFFNESS MATRIX SOLUTION FOR SHELLS OF REVOLUTION POSSESSING VARIABLE THICKNESS HEAT PROTECTION
Frederick Jean Stebbins (Ph.D. Thesis) 1966 224 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-259

A composite laminated torispherical shell was idealized as a network of curved beams. A stiffness matrix method was developed to analyze the structural model. The method was developed to torispherical coordinates which are amenable to the current family of manned spacecraft. The laminated shell was composed of an ablator, bond, 2 stainless steel face sheets, and a 2 inch thick stainless steel core. Thermal and mechanical loadings were considered. A structural model of the Apollo aft heat shield substructure was analyzed for a variety of thermal and mechanical loadings. A correlation was made of the analysis with test data and 2 independent digital computer analyses. An analysis of a hemisphere under hydrostatic loading was included to establish a link with "exact" theory. The development of the theory, transformations, Fortran programing effort, and substantiating data form the basis of the research. Selected stresses and displacements were used in comparisons to demonstrate the accuracy of the procedure. Dissert. Abstr.

N68-23494 New York Univ., N. Y.
THE BUCKLING OF A PLATE ON AN ELASTIC FOUNDATION
Jay Henry Wolkowisky (Ph.D. Thesis) 1966 63 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-643

A circular plate which is resting on an elastic foundation and subjected to compressive forces acting at its boundary and in the plane of the plate is investigated. The mathematical formulation of the problem leads to a system of non-linear differential equations. The equations are linearized in order to treat the problem approximately for small deflections. The linear system of equations and boundary conditions constitutes an eigenvalue problem; it is solved explicitly for the characteristic functions and the eigenvalues are obtained. This linear theory shows that the characteristic functions will have more and more zeroes (which correspond to nodal circles of the buckled state) as the stiffness of the elastic foundation increases. This is true, in particular, for the lowest buckling mode (the static corresponding to the lowest buckling pressure). Afterwards numerical solutions of the nonlinear problem are described for the first three types of buckled states that bifurcate from the unbuckled state at the eigenvalues of the linearized problem. Dissert. Abstr.

N68-23497# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYSIS OF THE COLLISION OF METAL BODIES ON THE BASIS OF A COMPRESSIBLE FLUID MODEL
A. N. Maryamov 1968 5 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. Ser. 1: Mat. i Mekhan. (Moscow), no. 6, 1967 p 109–113
(PB-177584T) CFSTI: HC $3.00/MF $0.65

Problems of the collision of solids moving at high velocities, the penetration into finite or semi-infinite obstacles, and the destruction of solids under the action of concentrated loadings such as high-speed jets, all lead to the analysis of problems on material behavior under intense dynamic loadings. Author (PB)

N68-23507 California Univ., Los Angeles.
MECHANICS OF MATERIALS WITH SPATIAL MEMORY
Yen Sha Pan (Ph.D. Thesis) 1966 310 p
Available from Univ. Microfilms: HC $13.95/MF $4.00 Order No. 67-556

A general constitutive equation is proposed for the study of nonlocal stress-deformation relations for a class of general materials. The construction of the equation is based on the principle of constitutive invariance advanced by Morgan. Various representations of this constitutive equation, under specific restrictions, are formulated by appropriate mathematical techniques. Based on these representations, several approximations to the constitutive equation are derived. By means of these approximations, contact with the classical theories is demonstrated. As an example, the proposed theory is applied to a one-dimensional problem, and the solution-technique is exhibited in detail. The results for this example are presented in graphical form and illustrate the fact that the proposed nonlocal theory can describe a wider range of physical phenomena than is possible with classical theories. Applications to higher dimensional problems are also discussed. As an extension of this theory, an outline of the development of a theory for materials with both space- and time-memory is also included herein. Dissert. Abstr.

N68-23508 California Inst. of Tech., Pasadena.
TRANSMISSION MATRICES AND LUMPED PARAMETER MODELS FOR CONTINUOUS SYSTEMS

Richard Dale Rocke (Ph.D. Thesis) 1966 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-194

The use of transmission matrices and lumped parameter models for describing continuous systems is the subject of this study. Non-uniform continuous systems which play important roles in practical vibration problems, e.g., torsional oscillations in bars, transverse bending vibrations of beams, etc., are or primary importance. A new approach for deriving closed form transmission matrices is applied to several classes of non-uniform continuous segments of one dimensional and beam systems. A power series expansion method is presented for determining approximate transmission matrices of any order for segments of non-uniform systems whose solutions can not be found in closed form. This direct series method is shown to give results comparable to those of the improved lumped parameter models for one dimensional systems. Dissert. Abstr.

N68-23539# National Aeronautical Lab., Bangalore (India).
STRESS AROUND CURVILINEAR HOLES IN SHELLS
G. N. Savin and A. N. Guz Sep. 1967 16 p refs Transl. into ENGLISH from Russian
(NAL-TT-2) CFSTI: HC $3.00/MF $0.65

An approximate method, which is based on the method of perturbation of the boundary shape, is presented for investigating the state of stress in shells around curvilinear holes of arbitrary shapes. As a result of the suggested method, it is shown that the solution of the problem for the hole of arbitrary shape leads to a solution of a series of boundary problems for a circular hole. Numerical examples are cited to illustrate that in the case of tension of a cylindrical shell along the generatrix, weakened by a small unreinforced hole of arbitrary shape, the maximum stress concentration factor in the shell differs very little from the maximum stress concentration factor in plates under the corresponding load. B.S.D.

N68-23548*# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
DUAL AND COMPLEX FORMULATIONS OF THIN SHELL EQUATIONS
Z. M. Elias Mar. 1968 42 p refs
(Grant NGR-22-009-059)
(NASA-CR-94592; R68-20) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The duality is established for the nonhomogeneous shell problem and is used as a basis for establishing the equations of two types of formulations: a dual or mixed formulation in which the unknowns are displacements and stress functions, and complex formulations in which the displacements and stress functions are combined into the real and imaginary parts of complex dependent variables. Author

N68-23611 Minnesota Univ., Minneapolis.
THE EFFECT OF SMALL BENDING STIFFNESS ON THE FREE VIBRATIONS OF A BAR UNDER AXIAL TENSION DUE TO ITS OWN WEIGHT
Darrell Albert Frohrib (Ph.D. Thesis) 1966 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-14

The natural frequencies of lateral vibration of a long wire-like bar in static tension under its own weight are primarily the same as those of the equivalent catenary. The general, nonlinear equations of free vibration for the bar in a torsionless state are derived using Bernoulli–Euler beam theory. These equations are then linearized for the case of free small amplitude vibration about the equilibrium configuration. Using linear singular perturbation theory, these equations are solved as asymptotic expansions with bending stiffness as the small parameter. The leading terms of these expansions are the free vibration solutions of the equivalent catenary, or chain, without bending stiffness, which are also determined for a wide range of horizontal tension. Specific numerical results are given in dimensionless form for the first three natural frequencies for a very wide range of horizontal tension and several appropriate values of bending stiffness for zero vertical force at the bottom. Dissert. Abstr.

N68-23652*# Alabama Univ., University. Dept. of Engineering Mechanics.
BIBLIOGRAPHY OF THE LITERATURE ON THERMAL FATIGUE
A. E. Carden Aug. 1967 122 p refs
(Grant NsG-381)
(NASA-CR-94605; MH-67-AEC-3) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An annotated bibliography is presented on fatigue at elevated temperature. Elevated temperature fatigue is defined as fatigue at any temperature where time dependent flow becomes significant. Reports dealing with isothermal and cyclic thermal tests, uniaxial and multiaxial tests, cyclic load tests, and interrupted constant load tests are included. The appendix contains references on thermal stress analysis. A list of references on fatigue, but not primarily related to thermal fatigue, is also included. R.N.A.

N68-23762*# Advisory Group for Aerospace Research and Development, Paris (France).
RESIDUAL STRENGTH IN THE PRESENCE OF FATIGUE CRACKS
Paul Kuhn (NASA. Langley Res. Center) 1967 89 p refs Presented at Struct. and Mater. Panel of AGARD, Sect. 1–4, Turin, 17 Apr. 1967 and Sect. 5–7, Ottawa, Can., 25 Sep. 1967
(AGARD-Advisory-11) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Results of a survey are presented which included visits to aeronautical organizations and firms. The purpose was to review the existing state of knowledge with respect to: (1) the residual strength of material specimens containing fatigue crack failure initiation of known proportions; and (2) the residual strength of typical structures using various types of materials. Rather than presenting a comprehensive summary, the report concentrates on the presentation and critical analysis of calculation methods useful to the structural engineer. Specially covered are methods for simple sheet specimens and the effects of thickness on sheet and plate with through-cracks and part-through cracks. K.W.

N68-23773# Washington Univ., Seattle. Lab. of Statistical Research.
A NEW FAMILY OF LIFE DISTRIBUTIONS
Z. W. Birnbaum and Sam C. Saunders (Boeing Sci. Res. Labs.) 22 Mar. 1968 20 p refs Sponsored in part by Boeing Co.
(Contract Nonr-477(38))
(TR-52; AD-667247)

A new two-parameter family of life length distributions is presented which is derived from a model for fatigue. This derivation follows from considerations of renewal theory for the number of cycles needed to force a fatigue crack extension to exceed a critical value. Some closure properties of this family are given and some comparisons made with other families such as the lognormal which have been previously used in fatigue studies. Author (TAB)

N68-23857 California Univ., La Jolla, Calif. Dept. of the Aerospace and Mechanical Engineering Sciences.
AXISYMMETRIC DYNAMIC SNAP THROUGH OF ELASTIC CLAMPED SHALLOW SPHERICAL SHELLS
N. C. Huang Feb. 1968 32 p refs
(Grant AF-AFOSR-1226-67)
(AFOSR-68-0469; TR-7; AD-667191)

The behavior of axisymmetric dynamic snap-through of elastic clamped shallow spherical shells under a uniform pressure has been investigated by several authors. In most of the previous work, approximate methods were used, and as yet no positive conclusion has been made on the critical load for snap-through. In this paper, a numerical method is developed for solving the governing non-linear differential equations of this problem. Two types of loading conditions are included--an impulsive load and an instantaneously applied step load with infinite duration. In the case of impulsive loading, it is found from the quasistatic problem under zero load that the only equilibrium position of the shell is its undeformed configuration. Hence there is no possiblity for dynamic snap-through under impulsive loading. In the case of step loading, the snap-through loads are evaluated for a wide range of the geometrical parameter of the shell. Comparison of the present calculated critical loads with the previous results from approximate methods is made. It is found that the present critical load checks closely with an experimental value of the critical load for one value of the geometrical parameter of the shell. Author (TAB)

N68-23938# University Coll., Cork (Ireland).
POLYGONAL AND SWEPT-BACK PLATES WITH CUT-OUTS AND COLUMN SUPPORTS
P. M. Quinlan *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968. Vol. 1 21 Mar. 1968 78 p 2 ref (See N68-23931 13-34)
(Grants AF-EOAR-65-40; AF-EOAR-67-31)

A general computer method is presented of solving a very wide range of sweptback wing and skew bridge problems with any boundary conditions and loadings; and with or without any number of cut-outs and elastic column supports. New computer formulae are established for polar and symmetrical edge-function biharmonics which provide complementary functions for adjusting to any prescribed boundary conditions. A single computer program handles all cases, the only inputs being a coded specification of the boundary conditions, locations for loading and columns, and a subroutine to give the plate shape. In contrast to finite difference and finite element methods, no convergence problems arise in the edge function method. Author

N68-23946# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
BUCKLING OF DISCRETELY RING STIFFENED CYLINDRICAL SHELLS
Josef Singer and Rafael Haftka Aug. 1967 62 p refs
(Contract AF 61(052)-905)
(TAE-67; AFOSR-68-0065; SR-2; AD-662358)

The buckling of ring-stiffened cylinders is studied by a discrete approach, in which the rings are considered as linear discontinuities represented by the Dirac delta function. The analysis is a linear Donnell type theory that takes account of the eccentricity of stiffeners. Buckling loads under hydrostatic pressure, lateral pressure and axial compression are compared with those obtained by smeared-stiffener theory for an extensive range of geometries. The discreteness effect depends very strongly on the geometry of the shell and the eccentricity of the rings. Significant discreteness effects are found for hydrostatic pressure loading. Author (TAB)

N68-23975# Naval Civil Engineering Lab., Port Hueneme, Calif.
FINITE ELEMENT ANALYSES OF SOLIDS OF REVOLUTION
S. K. Takahashi and S. B. Dong (Calif. Univ., Los Angeles) Mar. 1968 164 p refs
(NCEL-TR-567; AD-667235) CFSTI: HC $3.00/MF $0.65

Two finite element computer programs are described in this report. The programs are quite general and are applicable to a number of different problems, including many which may be encountered by the U. S. Navy in building deep ocean structures. The thin-shell solid-of-revolution program can be used to analyze both the axisymmetrically and the asymmetrically loaded shell composed of an arbitrary number of bonded layers, each with a different thickness and different elastic orthotropic properties. The thick-wall solid-of-revolution program can accommodate only an arbitrarily axisymmetrically loaded body of revolution. A sample problem is solved for each of the two computer programs presented in this report. Author (TAB)

N68-23992*# Wyle Labs., Inc., Huntsville, Ala.
PREDICTED VIBRATION RESPONSES OF APOLLO STRUCTURE AND EFFECTS OF PRESSURE CORRELATION LENGTHS ON RESPONSE
R. W. White Mar. 1967 74 p refs
(Contract NAS9-5810)
(NASA-CR-62066; WR-67-4) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This report contains a theoretical prediction of the vibration response levels of the Saturn Lunar Module Adaptor segment of the Apollo Spacecraft for aerodynamic turbulence at Mach 1 and Mach 2, for a reverberant acoustic field, and for a modified acoustic progressive wave field. The structure is idealized to a uniform, thin cylindrical shell with pinned ends, and is analyzed by the classical modal method which incorporates 570 structural modes having resonance frequencies in the range of 0–1000 Hz. The purpose of the analysis is to evaluate the modified progressive wave field which is assumed to be generated within a specially designed shroud of sixteen axially oriented ducts which are constructed around and contoured to the skin of the Apollo vehicle. Acceleration response spectra are presented for a flat pressure excitation spectrum; and 1/2-octave band average responses are obtained by integration of these response spectral densities. Author

N68-24034 New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
THE EFFECT OF A UNIFORMLY DISTRIBUTED LATERAL LOAD UPON THE BUCKLING OF A CONTINUOUSLY SUPPORTED BEAM
Arnold K. Kerr May 1967 15 p refs
(Grant AF-AFOSR-813-67)
(NYU-AA-67-103; AFOSR-67-1398; AD-667392)

The effect of gravity forces upon the buckling of concrete highways or airfield runways as well as upon the stability of a thin layer embedded in a continuous medium, suggest the study of a longitudinally compressed infinite beam which is continuously supported by a relatively soft foundation and is additionally subjected to a uniform lateral load. It was found, that if the response of a continuous foundation model is assumed linear, then the uniform lateral load, irrespective of its magnitude, has no effect upon the determined buckling force. It is then shown, using the Winkler model, that if the response is assumed nonlinear, which is usually observed in real situations, then the lateral load does affect the buckling force. Namely, the larger the uniform lateral pressure, the more stable the continuously supported beam. Author (TAB)

N68-24038# National Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
FATIGUE CRACK NUCLEI IN 7075-T6 TENSION SKINS REVEALED BY DESTRUCTIVE TESTING
J. Schijve and P. de Rijk Jun. 1967 40 p refs
(NLR-TN-S.657) CFSTI: $3.00

Tension skins left from full-scale fatigue tests were stripped. Tensile tests revealed various nuclei previously undetected. The indication of part-through cracks by X-raying of a tensile loaded and an unloaded structure is analysed. Results also bear upon the significance of the maximum load adopted in a full-scale fatigue test. Author

N68-24040# Aberdeen Proving Ground, Md. Ballistic Research Lab.

DYNAMICS OF A LIQUID-FILLED SHELL: CYLINDRICAL CAVITY WITH A CENTRAL ROD

John T. Frasier and Wayman E. Scott Feb. 1968 66 p refs

(BRL-R-1391; AD-667365)

A stability criterion is derived for a gyroscope containing liquid in a right circular cylindrical cavity with a rigid, circular rod along its axis. The criterion has practical significance for liquid-filled projectiles with central bursters. Recommendations are given for the design of such projectiles. For quantitative application of the theoretical results, a numerical tabulation of certain functions appearing in the analysis is required and is provided in an appendix. Author (TAB)

N68-24045# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

A VARIATIONAL PRINCIPLE AND THE CONVERGENCE OF A FINITE-ELEMENT METHOD BASED ON ASSUMED STRESS DISTRIBUTION Interim Scientific Report

Pin Tong and Theodore H. H. Pian Jan. 1968 23 p refs

(Contract F44620-67-C-0019)

(ASRL-TR-144-1; AFOSR-TR-68-0384; AD-667813)

A variational principle is formulated as the foundation of the finite-element method proposed by Pian. Through this formulation an extension of Pians original proposal is made and the convergence of the approximate solution to the exact one is proved. Author (TAB)

N68-24116 Arizona Univ., Tucson.

DEVELOPMENT OF A LOCAL BUCKLING THEORY FOR UNIFORMLY LOADED SPHERICAL CAPS

Donald Earle Milks (Ph.D. Thesis) 1966 149 p

Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-1079

The buckling pressure of a uniformly loaded spherical cap is predicted by the use of a local buckling assumption. With the aid of a digital computer program, an analytical solution is obtained by means of a power series expansion of the variables involved in the defining nonlinear differential equations. Critical values of the loading parameter are found in terms of a geometric parameter using edge conditions of full restraint, no restraint and partial restraint. Tests on eighty polyvinyl chloride shells, which were vacuum formed into four different degrees of shallowness, are reported to support the analytical results. All shells buckled by dimpling. The size of the dimple is determined experimentally by comparing measured deflections at loads below the critical pressure with the analytical values. The dimple size is determined analytically for all three edge conditions on the basis of the minimum buckling pressure which satisfies the defining equations. An expression for the buckling pressure of any uniformly loaded spherical cap is presented. Dissert. Abstr.

N68-24122*# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

ON THE DERIVATION OF VLASOV'S SHALLOW SHELL EQUATIONS AND THEIR APPLICATION TO NON SHALLOW SHELLS

Z. M. Elias Nov. 1967 32 p refs

(Grant NGR-22-009-059)

(NASA-CR-94591; R67-67) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Use is made of the static geometry analogy to show that Vlasov's equation may be derived on the assumption that tangential components of displacements may be neglected in computing the changes of curvature of the middle surface, and that the transverse shear stress resultants may be neglected in the tangential equilibrium equations. Based on this derivation, the nature of the error in Vlasov's shallow shell equation is made, and the order of magnitude of this error for non-shallow shells is established depending on the geometry of the shell and on the boundary conditions. B.S.D.

N68-24132# National Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

STATIC TESTS ON CRACKED PANELS OF 2024-T3 AL CLAD SHEET MATERIALS FROM DIFFERENT MANUFACTURERS

D. Broek Aug. 1966 27 p refs Sponsored by the Neth. Aircraft Develop. Board

(NLR-TN-M.2164) CFSTI: HC $3.00/MF $0.65

Results are presented of residual strength tests on cracked specimens of 2024-T3 sheet material from five different manufacturers. Systematical differences in residual strength were found. The report gives a discussion of the correlation between residual strength and the number of inclusions. Practical aspects of the results are considered. Author (ESRO)

N68-24134# Aeronautical Research Council (Gt. Brit.)

STATIC INSTABILITY OF RECTANGULAR ORTHOTROPIC PANELS SUBJECTED TO UNIFORM IN-PLANE LOADS AND DEFLECTION-DEPENDENT LATERAL LOADS

D. J. Johns (Loughborough Univ. of Technol.) 17 Jul. 1967 36 p refs

(ARC-29281) CFSTI: HC $3.00/MF $0.65

Various analyses are presented for orthotropic and isotropic panels from which several elastic stability characteristics can be obtained. The loadings considered are biaxial in-plane compression and lateral loads which are dependent on the panel deflections (typically aerodynamic loadings). The panels are assumed to be resting on an elastic foundation to increase the generality of the problem. The analyses are valid for panels whose edges experience no lateral deflection but which are in general elastically restrained against rotation. The application of the analyses to particular configurations is shown and for certain isotropic panels correlation with experiment is found. Author (ESRO)

N68-24151*# Computing Devices of Canada, Ltd., Ottawa (Ontario).

IMPACT FLASH FOR MICROMETEOROID DETECTION Final Report

T. L. Rollins and B. Jean 7 May 1968 98 p refs

(Contract NAS9-6790)

(NASA-CR-92122; Rept.-9899/FRI) CFSTI: $3.00 CSCL 20K

The radiation emitted during hypervelocity impact consists of emission lines of the target and projectile material and continuum radiation associated with the broadening of these lines. Spectroscopic observation of the radiation emitted yields information about the composition, velocity, and size of the impacting particle. When the composition is known, the velocity and diameter can be obtained from simple measurements involving only one photomultiplier. A possible application is the detection of micrometeoroids and measurement of their velocity and size. Author

N68-24178# Naval Civil Engineering Lab., Port Hueneme, Calif.

PHOTOELASTIC INVESTIGATION OF STRESS CONCENTRATIONS IN SPHERE-CYLINDER TRANSITION REGIONS: INCLUDING A COMPARISON OF RESULTS FROM PHOTOELASTIC AND FINITE ELEMENT ANALYSES Final Report, 1 Jul. 1966–30 Jun. 1967

S. K. Takahashi and R. Mark Apr. 1968 108 p refs

(NCEL-TR-572; AD-667834) CFSTI: HC $3.00/MF $0.65

The study investigates stress distributions in sphere-cylinder transition regions of externally pressurized thick-walled vessels; it

compares data determined by two different approaches: photoelastic analysis and finite element computer programs. These approaches afford a capability for analyzing complicated deep ocean structures that are of considerable interest to the U. S. Navy. Two small-scale epoxy models of the prototype structures were loaded by 4- and 10-psi external pressure at a critical temperature (290F) and then the stresses were frozen by cooling the material. The first model had relatively thin walls (cylinder diameter-to-wall thickness ratio = 15), and incorporated 60% balanced opening reinforcement at the transition. The amount of reinforcement is expressed as a percentage of the material removed from the vessel shell to form the opening. The reinforcement is balanced when equal amounts are placed on the inside and outside of the vessel. The second had a cylinder diameter-to-wall thickness ratio of 4, and 65% balanced opening reinforcement. After stress freezing, the models were sliced longitudinally and transversely and the meridional and circumferential stresses were determined photoelastically with a diffused-light polariscope. The photoelastic solutions were used to verify the stresses calculated by finite element computer programs. Excellent correlation was obtained for the comparison of meridional and circumferential surface stresses by the photoelastic and finite element procedures. Author (TAB)

N68-24230 California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
ON THE DIFFUSION OF LOAD FROM A TRANSVERSE TENSION-BAR INTO A SEMI-INFINITE ELASTIC SHEET Research Report
R. Muki and Eli Sternberg Feb. 1968 42 p refs
(Contract Nonr-220(58))
(TR-14; AD-667600)

The paper deals with the load-diffusion from a tension-bar of finite length and uniform cross-section into a semi-infinite sheet, the axis of the bar being perpendicular to the edge of the sheet. The bar is regarded as a one-dimensional elastic continuum, whereas the elastic sheet is treated within the two-dimensional theory of generalized plane stress. Three alternative models for the stringer-attachment are considered: (a) line-contact; (b) area-contact based on matching the axial stringer-strain and the corresponding average sheet-strain across the width of the strip of adhesion; (c) area-contact based on matching the stringer-strain and the corresponding sheet-strain along the centerline of the strip of adhesion. It is shown that the line-contact model, in contrast to both area-contact models, does not admit the transmission of portions of the applied load through forces concentrated at the ends of the adhering bar-segment. Further, asymptotic estimates are deduced for the end-slopes of the load-diffusion curves appropriate to the three models under consideration. The integro-differential equation for the stringer-force in Case (b) and Case (c) is reduced to a standard Fredholm integral equation, which is solved numerically. The results thus obtained are compared with available experimental findings. Author (TAB)

N68-24237 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN APPROXIMATE SOLUTION FOR SYMMETRIC VIBRATION IN SPHERICAL SHELLS
Ch'i-Kan Sung 13 Nov. 1967 13 p refs Transl. into ENGLISH from Acta Mechanica Sinica (China), v. 7, no. 4, 1964 p 335–341
(FTD-HT-23-550-67; AD-667703)

Contents: Precise method of calculating the self-vibration frequency; Flat shell theory; Momentless theory; Approximation formula. TAB

N68-24282# National Research Council of Canada, Ottawa (Ontario).
VIBRATION MODES AND RANDOM RESPONSE OF A MULTI-BAY PANEL SYSTEM USING FINITE ELEMENTS
Gary M. Lindberg and Mervyn D. Olson Dec. 1967 69 p refs
(NRC-10001; LR-492) CFSTI: HC$3.00/MF$0.65

A finite element approach to the dynamic analysis of continuous skin-stringer panels is presented. The method is illustrated in the calculation of vibration modes and random response of a five-bay stringer-stiffened panel with all outer edges clamped. The panel skin is represented by finite plate elements and the stringers, which are assumed infinitely stiff in bending, are represented by beam torsional elements. Results are presented for the first 35 panel vibration modes. These modes occur in distinct groups with five similar modes in each, the number five corresponding to the number of panel bays. The response of the panel to plane wave propagation of acoustic noise (propagating normal to the stringers) is also calculated. The resulting response power spectral densities were found to be fundamentally different from those associated with single span panels. Author

N68-24296# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
AN APPLICATION OF THE EXTENDED KANTOROVICH METHOD TO THE STRESS ANALYSIS OF A CLAMPED RECTANGULAR PLATE Interim Scientific Report
Arnold D. Kerr and Harold Alexander Jul. 1967 32 p refs
(Grant AF-AFOSR-813-66)
(NYU-AA-67-107; AFOSR-67-1580; AD-667201)

The extended Kantorovich method discussed recently by A. D. Kerr, is used to analyze a clamped rectangular plate subjected to a uniform lateral load. It was found that the generated one term solution approximates very closely, throughout the plate region, not only the deflections but also the bending moments and shearing forces. It is shown that the final form of the solution is independent of the initial choice, and that the convergence of the iterative procedure is very rapid. Because of the lack of a closed form exact solution in the technical literature, the coefficients occurring in the obtained solution were evaluated for various plate side ratios and are presented in graphs in order to simplify the utilization of the obtained results in engineering practice. Author (TAB)

N68-24305 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL STATE OF GAS TURBINE ROTOR DISKS AND THEIR TEMPERATURE STRESSES [TEPLOVOYE SOSTOYANIYE DISKOV GAZOVYKH TURBIN I TEMPERATURNYYE NAPRYAZHENIYA V NIKH]
G. A. Kuz'min 13 Oct. 1967 17 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 76, 1963 p 74–88
(FTD-HT-23-705-67; AD-667702)

Both the stationary and transient thermal states were considered. Thermal analysis was limited to the convective heat exchange, neglecting the relatively insignificant contributions of radiation and heat conductivity. Analysis of the stationary case was facilitated by assumptions of a thin rotor disk of uniform thickness and symmetrical heat dissipation, thus admitting a direct solution in terms of modified Bessel functions. Solutions for the non-stationary case of the engine start were obtained by a graphical method. It was noted that the rotor disk periphery temperature reaches its maximum (600C) soon after the engine start, while the central portion approaches its maximum temperature at a much slower rate. Thus the turbine rotor is seen to possess a high thermal inertia, and the maximum temperature difference between its periphery and center occurs soon after the engine start. This means that little thermal stress relief can be obtained by prolonging engine warm-up. Radial and circular stresses were calculated for theoretically and for experimentally determined data. Stress distributions are presented in graphs. Author (TAB)

N68-24332# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MEASUREMENT OF BORON FILAMENTARY COMPOSITE BEHAVIOR RELATIVE TO MECHANICAL DESIGN OF RE-ENTRY VEHICLE STRUCTURES

L. Cohen Nov. 1967 74 p refs Presented at the 22nd Ann. Reinforced Plastics Tech. and Management Conf. of the Soc. of the Plastics Ind., Inc., Washington, D. C., 31 Jan. 1967
(Doc.-67SD344)

A recent development program concerned reentry vehicle component design, fabrication and evaluation with boron filament–epoxy resin composites. The extremely high elastic modulus of the reinforcement relative to that of the matrix resin increased the normal difficulties in mechanical testing of this composite material. An experimental program utilizing specialized test methods was carried out to obtain design data. The tests provided data useful for guidance of materials processing studies and of fabrication technology development related to filament winding. Author

N68-24343# Sandia Corp., Albuquerque, N. Mex.
LARGE DEFLECTION DYNAMIC ELASTIC–PLASTIC RESPONSE OF CLAMPED BEAMS SUBJECTED TO EXPLOSIVE LOADING
R. D. Krieg and T. A. Duffey Feb. 1968 78 p refs
(Contract AT(29-1)-789)
(SC-RR-67-848) CFSTI: HC $3.00/MF $0.65

DuPont EL506D sheet explosive was used to load the center 2 inches of 10-inch-long clamped beams. The beams were made of 1022 steel and 6061-T6 aluminum. A streak camera and high-speed framing camera were used to record the motion of the beams. Strain gages recorded surface strains at several locations on each beam. All beams experienced plastic strains in the large deflection region. Author (NSA)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-23050 Rensselaer Polytechnic Inst., Troy, N. Y.
CALCULATION OF THERMODYNAMIC EXCESS FUNCTIONS: THE SYSTEM ETHANOL–*N*-HEPTANE
Nand Kumar Kochar (Ph.D. Thesis) 1966 167 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-4181

Thermodynamic excess functions for the liquid binary system–n-heptane over the temperature range 0–90°C have been calculated from vapor-liquid equilibrium data and heat of mixing data. The results are expressed as functions of temperature for various compositions. Methods are also presented for the calculation of phase equilibria at either constant temperature or constant pressure. Experimental measurements of the vapor pressure of acetone-acetonitrile solutions are also presented in this work. Dissert. Abstr.

N68-23068# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS FOR MEASURING LARGE HEAT FLUXES [K VOPROSU O METODAKH IZMERENIYA BOL'SHIKH TEPLOVYKH POTOKOV]
V. L. Sergeyev 19 Sep. 1967 14 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. (Moscow), v. 9, no. 4, 1965 p 427–432
(FTD-HT-67-57; AD-666743)

A number of methods are used for measuring heat fluxes in high-temperature jets and shock tubes: the exponential, i.e., calorimetric method (according to the heat quantity stored in a sample); according to the surface temperature of a sample; the method of surface points (according to temperature change at the ends of a sample); according to the time interval before commencement of melting; the method of a cooled calorimeter (according to heating and consumption of cooled water). With the aid of the exponential method and a cooled calorimeter, distributions of heat fluxes in the cross-section of a high-temperature gas jet are measured. The results obtained by the two methods agree quite well. Author (TAB)

N68-23070 Florida Univ., Gainesville.
INTERMOLECULAR INTERACTION FOR POLAR AND NONPOLAR MOLECULES CORRELATED WITH PROPERTIES OF GASES
Jae Ho Bae (Ph.D. Thesis) 1966 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-3459

This work is concerned with the pair-potential energy functions for the prediction of thermodynamic and transport properties of polar and nonpolar gases. The potential parameters for ten nonpolar molecules are determined from the experimental second virial coefficients. The experimental data are reproduced very well and the agreement is comparable with other potentials. This model is also extended to 12 binary gas mixtures for which the second virial coefficients are predicted quite adequately. For polar molecules the transport properties of dilute gases are reproduced accurately by the 12-6 pair-potential energy function with temperature-dependent parameters. The estimated parameters give reasonable results in the calculation of both thermodynamic and transport properties of polar gases. The transport properties of nonpolar gases are correlated with the saturated liquid density parameters through the principle of corresponding states. Dissert. Abstr.

N68-23085# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
TWO PHASE GAS LIQUID FLOW DYNAMICS. PART 1: FLOW OSCILLATION IN TRANSPARENT, PARALLEL, VERTICAL, HEATED CHANNELS. PART 2: ACOUSTIC VELOCITY IN TWO-PHASE FLOW Topical Report, 1 Feb. 1965–30 Nov. 1967
S. William Gouse, Jr. (Carnegie-Mellon Univ.), Rowland G. Evans, Charles W. Deane, and John C. Crowley Nov. 1967 121 p refs Presented at the Symp. on Two Phase Flow Dyn., Netherlands, Sep. 1967
(Contract Nonr-3963(15))
(DSR-74629-1; AD-666618)

A natural and forced convection closed loop with three, parallel, vertical, transparent, heated channels with a constant pressure drop maintained across the heated channels, employing refrigerant 113 as the test fluid, was constructed and operated. Regions of uniform and oscillating flow were mapped for the following range of variables: (a) pressure level at the heated section inlet, 10-20 psig; (b) inlet subcooling to 90F; (c) mass flow rate per test section to 1200 lbm/hr; (d) uniform heat flux to 16,000 BTU/hr-sq ft. The state of the art in the measurement and prediction of the acoustic velocity in one and two-components two-phase mixtures and flows was reviewed and summarized. As the void fraction of a two-phase gas-liquid mixture increases continuously from zero to approximately 60 per cent, the propagation velocity of a pressure wave in the two-phase mixture decreases from its value in the liquid phase to a minimum and begins to rise. At the point where the liquid phase ceases to be continuous there can be a rapid rise in propagation velocity to a value approaching that in the gas phase alone. However, it was observed that in the range of void fractions, from 0.6 to 1.0, there is a range of propagation speeds which depends on the frequency of the propagating signal, the size distribution of discontinuous phase, the nature of the continuous phase, and the strength of the disturbance. Author (TAB)

N68-23098# North Carolina State Coll., Raleigh.
A STUDY OF THE OPERATING CHARACTERISTICS OF THE HEAT PIPE Progress Report During the Ninth Quarter, Jul.–30 Sep. 1967
J. K. Ferrell 1 Nov. 1967 13 p
(Contract AT(40-1)-3411)
(ORO-3411-9) CFSTI: HC $3.00/MF $0.65

The design of an experimental apparatus to study heat transfer to wetted beds at atmospheric and elevated pressures (up to 200 psi) has been completed and the apparatus is under construction. The solution technique for the distributions of pressure, mass flux, temperature and heat flux in a flat-plate heat pipe is discussed. NSA

N68-23099# North Carolina State Coll., Raleigh.
A STUDY OF THE OPERATING CHARACTERISTICS OF THE HEAT PIPE: CAPILLARITY IN POROUS MEDIA Progress Report During the Tenth Quarter, 1 Oct.–31 Dec. 1967
J. K. Ferrell and E. M. Schoenborn 20 Feb. 1968 17 p refs
(Contract AT(40-1)-3411)
(ORO-3411-10) CFSTI: HC $3.00/MF $0.65

Falling capillary equilibrium heights of water in porous media were determined under adiabatic and evaporative (boiling) conditions at atmospheric pressure. The packed beds consisted of stainless steel particles (40 to 100 mesh) and glass beads (80 to 100 mesh). For the glass beads, capillary heights were correlated as a function of the specific evaporation rate of the working fluid and found to be independent of evaporation rate over the range (0 to 50 lb/hr-ft^2) studied. The data were explained by assuming that the sole effect of imposing a heat flux on the porous media was to change the surface tension and density of the liquid water. The effect of reduced surface tension and density alone were sufficient to explain the observed results; apparently no change in cost θ/r was affected by the imposition of the heat flux. Author (NSA)

N68-23106# California Univ., Livermore. Lawrence Radiation Lab.
OPACITY OF SMOKES FROM CERTAIN WOODS AND PLASTICS UNDER SMOLDERING AND BURNING CONDITIONS
James R. Gaskill and Charles R. Veith 28 Nov. 1967 10 p refs Presented at ACS Symp. on the Flammability Characteristics of Polymers, San Francisco, 31 Mar.–2 Apr. 1968
(Contract W-7405-ENG-48)
(UCRL-70794; CONF-680305-1) CFSTI: HC $3.00/MF $0.65

Work is being carried out to develop an acceptable test system to determine the opacity and toxicity of products evolved from smoldering or burning materials. A smoke chamber was built; it consists of an 18 ft^3 metal sample holder, a vertical path light source and phototube system, and an exhaust fan. The opacity of smokes from a number of woods and plastics was determined. NSA

N68-23134*# Arizona State Univ., Tempe. Dept. of Mechanical Engineering.
HEAT TRANSFER BETWEEN SURFACES IN CONTACT: THE EFFECT OF LOW CONDUCTANCE INTERSTITIAL MATERIALS. PART 1: EXPERIMENTAL VERIFICATION OF NASA TEST APPARATUS
P. A. Smuda, L. S. Fletcher, and D. A. Gyorog Apr. 1968 110 p refs Revised
(Grant NGR-03-001-003)
(NASA-CR-73122; ME-TR-033-1, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Literature on thermal conductance of metallic contacts with interstitial fillers in various environments is reviewed. The test apparatus, which contained a vacuum chamber, was designed with the aim of subjecting the test samples to various environments and physical conditions while obtaining accurate measurements. Tests were carried out with iron and aluminum specimens in contact in a vacuum environment. The test results were used to refine the test section configuration and to set up operating procedures for the apparatus. The final test section configuration consisted of the instrumented test specimens, the fluid cooled sink, the band heater source, an axial insulator, an axial guard heater, and radiation shields. The band heater was insulated with glass wool and covered with aluminum foil. The apparatus and techniques used are considered satisfactory for the investigation of thermal contact conductance with interstitial materials. Test apparatus drawings, calibration data, uncertainty analysis, and thermal conductivity measurements are included. E.C.

N68-23173# Aeronautical Research Council (Gt. Brit.).
A SURVEY OF THE THERMAL CONDUCTANCE OF METALLIC CONTACTS
H. Y. Wong London HMSO 1968 38 p refs Supersedes ARC-26715
(ARC-CP-973) CFSTI: HC $3.00/MF $0.65

The problem of thermal conductance of metallic contacts has become increasingly a problem of considerable significance in many practices of engineering and has received a great deal of attention in recent years. The present paper is a general survey of the field, and contains a lengthy list of references. Author (ESRO)

N68-23175 Pennsylvania Univ., Philadelphia.
THE THERMODYNAMIC PROPERTIES OF VARIOUS LIQUID FERROUS ALLOYS
Richard James Fruehan (Ph.D. Thesis) 1966 219 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-3069

The thermodynamic properties of various liquid ferrous alloys have been investigated. The vapor effusing from a Knudsen cell was analyzed by use of a time of flight mass spectrometer. A new technique for treating mass spectrometer data in order to determine the thermodynamic properties of solutions is presented. The method consists of measuring the ratio of the ion currents of the components in the solution as a function of temperature for a sufficient number of alloys to cover the entire composition range. This technique was applied to the following liquid metal systems; Fe-Ni, Fe-Co, Fe-Cr, Fe-Al, Ag-Al, and Fe-Ni-Cr. For the systems which reliable thermodynamic data exists, good agreement was obtained between this data and the data of the present study. Attempts to fit the experimental data to present solution theories in general were not successful. Dissert. Abstr.

N68-23178 Northwestern Univ., Evanston, Ill.
ANALYTICAL STUDY OF UPPER LIMIT FLAMES
Beshir Ahmed B. El Abbadi (Ph.D. Thesis) 1966 168 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-4216

Fuel-rich mixtures of propane and air flowing from minus infinity into a stationary flame front at $x = 0$ were analyzed. As the combustible gases flow in the positive direction, oxygen and propane are consumed until their concentration becomes zero at $x = 0$. The burning of propane (or any other hydrocarbon) is assumed to be catalyzed by hydrogen atoms that are formed in the flame zone and diffuse upstream. The overall rate of chemical reaction is assumed to depend on temperature and concentration of oxygen and atomic hydrogen. The temperature dependence of the reaction rate is proportional to the square root of the absolute temperature times Arrhenius exponential function ($T^{1/2} e^{-E/RT}$). Dissert. Abstr.

N68-23192*# Aeronutronic, Newport Beach, Calif.
INVESTIGATION OF HEAT TRANSFER IN NONEQUILIBRIUM REACTING SYSTEMS Final Report, 14 Jul. 1964–1 Apr. 1968

John L. Richardson and Richard J. Getz 1 Apr. 1968 138 p refs
(Contract NASw-999)
(NASA-CR-94538; U-4347) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An experimental investigation was undertaken in order to determine how finite homogeneous reaction rates affect energy transfer rates in the case of fully developed turbulent tube flow. Both the time-average and turbulent scalar properties of the nonequilibrium reacting flow were measured and compared to similar data obtained for the case of nonreacting turbulent tube flow. Special instrumentation and a recirculating flow system were developed for use with the gaseous reacting NO_2 system at elevated temperatures and pressures. The results show how the existing model for predicting the effect of reaction rate on heat transfer rate must be modified to obtain better agreement between theoretical predictions and experimental data. The turbulence measurements showed that the concentration and temperature fluctuation intensities are unusually large when the flow is undergoing a homogeneous nonequilibrium reaction compared with the intensities measured in a similar, but nonreacting, flow. This result explains in part why the existing prediction model is of limited use.
Author

N68-23224 California Univ., Los Angeles.
BROWNIAN MOTION ON COMPLETE RIEMANNIAN MANIFOLDS
John Wynne Evans (Ph.D. Thesis) 1966 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4488

On a complete C^∞ Riemannian manifold M let Δ represent the Laplacian operator. It is known that a well defined fundamental solution to the heat equation may be constructed as the limit of a sequence of fundamental solutions for the heat equation on relatively compact sets each of which is zero on the boundary of its domain of definition. It is shown that there is a continuous (path) Markov process among the equivalent processes having this fundamental solution as a transition density function with respect to the measure associated with the Riemannian metric. Such a continuous process is called a Brownian motion on M.
Dissert. Abstr.

N68-23231*# General Electric Co., Schenectady, N. Y. Research and Development Center.
STABILITY INVESTIGATION OF THERMALLY INDUCED FLOW OSCILLATIONS IN CRYOGENIC HEAT EXCHANGERS
Final Report
J. C. Friedly, J. L. Manganaro, and F. G. Kroeger Oct. 1967 153 p refs
(Contract NAS8-21045)
(NASA-CR-61745; S-68-1023) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analytical model describing thermally induced flow oscillations in heat exchangers for supercritical fluids has been compared with experimental data. The model is basically that developed previously by Dr. Novak Zuber. The effect of the heat transfer rate to the tube wall has been added. The model and the data are shown to be consistent and reasonably close in agreement on the appearance of the oscillations. It is found that the rate of heat transfer plays an important role in stabilizing the system. From the full model a greatly simplified stability criterion is derived. The criterion is a single equation stating that for stability a ratio of stabilizing to destabilizing pressure drops must be greater than an expansion factor. All parameters in the criterion are theoretically based and can be predicted in advance; the criterion reduces directly to the correlation used successfully by Thurston. Therefore, it should be used as a design tool.
Author

N68-23396* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HYPERVELOCITY HEAT PROTECTION: A REVIEW OF LABORATORY EXPERIMENTS
Nick S. Vojvodich [1968] 4 p refs
(NASA-TM-X-61088) CFSTI: $3.00 CSCL 20M

Laboratory experiments conducted in arc jet wind tunnel test facilities are reviewed in terms of providing macroscopic details on hypervelocity heat protection. Attention is given to the surface heat shielding, the rate at which the material recedes, and the degree of internal temperature rise for Teflon, phenolic nylon, an epoxy novolac resin in a glass honeycomb, and a silicone elastomer. Heating terms which arise from the interaction of the ablator and the environment are treated; as are the identification of chemical species and the blockage of convective heating, the surface position boundary condition, char thickness dependence on environmental parameters, and pyrolysis gas enthalpy determination.
M.W.R.

N68-23441 Oregon State Univ., Corvallis.
TRANSPIRATION COOLING OF A CYLINDER IN CROSSFLOW
Eugene Elzy (Ph.D. Thesis) 1967 315 p
Available from Univ. Microfilms: HC $14.20/MF $4.05 Order No. 67-5400

The effects of high mass transfer rates on the transport characteristics of steady, laminar, constant-property boundary layers were studied experimentally and theoretically. Experiments were conducted by uniformly injecting hot air from a one inch diameter cylinder made of rolled porous 200×1400 mesh stainless steel screen mounted in a subsonic wind tunnel. Local wall temperature was measured by rotating the cylinder and reading the emf of forty gauge thermocouples spot-welded to the inside wall of the cylinder. The Reynolds number was varied from 4,495 to 71,120 and the turbulent intensity was varied from 0.5% to 12.4% for a wide range of injection rates at the surface. Experimental results at the forward stagnation point are within 10% of the theoretical results for plane stagnation flow for all injection rates for Reynolds numbers over the entire range studied.
Dissert. Abstr.

N68-23448 Rensselaer Polytechnic Inst., Troy, N. Y.
THEORETICAL STUDY OF HEAT TRANSFER FOR ANNULAR TWO-PHASE FLOW
Harold Russell Kunz (Ph.D. Thesis) 1966 293 p
Available from Univ. Microfilms: HC $13.30/MF $3.80 Order No. 67-4183

An analysis is presented of annular, two-phase flow inside of circular tubes. Shear stress and heat flux distributions are derived for the liquid film and are combined with empirical expressions for turbulent diffusion coefficients of momentum and heat obtained from single-phase, fully-developed pipe flow to enable calculation of the liquid velocity and temperature profiles. The liquid film thicknesses and local heat transfer coefficients for condensation and evaporation of pure substances can be calculated from the velocity and temperature profiles. Pertinent dimensionless groupings are derived for both film thickness and heat transfer coefficient. The film thickness parameter is found to be dependent on the liquid Reynolds number, with secondary effects due to dimensionless tube radius, wall heat flux level, and tube orientation in the gravitational field. The heat transfer parameter is found to be dependent on the liquid Reynolds and Prandtl numbers with secondary effects due to the same parameters as for film thickness.
Dissert. Abstr.

N68-23483 University of Southern Calif., Los Angeles.
SATURATED POOL BOILING OF WATER IN A REDUCED GRAVITY ENVIRONMENT
Sidney Howard Schwartz (Ph.D. Thesis) 1966 311 p
Available from Univ. Microfilms: HC $14.20/MF $4.00 Order No. 67-429

The purpose of this investigation was to study pool boiling of distilled saturated water at one atmosphere of pressure under reduced gravity conditions. The low gravity environment was provided by an Aero Commander aircraft flying a Keplerian trajectory that resulted in an 8 to 10 second low gravity period. Tests were made with heat fluxes ranging from 2,000 to 68,000 Btu/hr-ft^2 at average gravity levels ranging from 0.02 to 0.30 g_e. The test heater was a horizontal electrical resistance ribbon 2.75 inches long and 0.25 inches wide with electrical current supplied by a 24 volt DC battery. Thermocouples attached to the insulated surface of the ribbon measured the heater surface temperature. Simultaneous high speed motion picture coverage at approximately 400 frames per second was employed to record the boiling phenomenon visually. Dissert. Abstr.

N68-23496# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON TAKING ACCOUNT OF SCATTERING IN RADIANT HEAT EXCHANGE PROCESSES
Yu. A. Popov 1968 6 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. (Moscow), v. 13, no. 4, 1967 p 496–501
(PB-177585T) CFSTI: $3.00/MF $0.50

The problem of isotropic radiation passing through a dissipating layer with a spherical scattering index and the problem of radiation of a constant temperature layer are solved by the Bubnov–Galerkin method. Author (PB)

N68-23505 Oregon State Univ., Corvallis.
THE CONVERGENCE OF THE DISCRETE ORDINATES METHOD FOR INTEGRAL EQUATIONS OF ANISOTROPIC RADIATIVE TRANSFER
Merlynd Keith Nestell (Ph.D. Thesis) 1966 76 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-734

Let $I(\tau,\mu)$, $J(\phi,\mu)$ and $\Gamma(\tau,\mu)$ denote intensity, average intensity and source function for radiation in a plane-parallel, anisotropically scattering medium with optical thickness $\tau_0 \leq \infty$ and albedo $\omega_0 \leq 1$. Let $I_m(\tau,)$, $J_m(\tau,\mu)$ and $\Gamma_m(\tau,\mu)$, $m \leq 1$, denote discrete ordinates approximations to $I(\tau,\mu)$, $J(\tau,\mu)$ and $\Gamma(\tau,\mu)$ respectively. The transfer problem and its associated approximate problem are studied in integral form using Neumann series techniques and positive operator theory. It is proved that, under suitable auxiliary conditions, $I_m(\tau,\mu) \rightarrow I(\tau,\mu)$, $J_m(\tau,\mu) \rightarrow J(\tau,\mu)$ and $\Gamma_m(\phi,\mu) \rightarrow \Gamma(\tau,\mu)$. The convergence is uniform if $\tau_0 < \infty$ and $\omega_0 \leq 1$ or if $\tau_0 = \infty$ and $\omega_0 < 1$. Error bounds are obtained when $\tau_0 < \infty$ and $\omega_0 \leq 1$. The convergence is uniform on each finite τ interval if $\tau_0 = \infty$ and $\omega_0 = 1$. Dissert. Abstr.

N68-23509 New York Univ., N. Y.
A NON-LINEAR SPECTRAL MODEL OF CONVECTION IN A FLUID UNEVENLY HEATED FROM BELOW
Richard Chapin James Somerville (Ph.D. Thesis) 1966 50 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-636

A two-dimensional form of the Boussinesq equations is integrated numerically for the case of a rectangular channel with a temperature gradient maintained along the bottom. The side walls are insulating, the top wall has a constant temperature, and the velocity obeys free boundary conditions on all four walls. The fields of stream function and temperature departure are represented by truncated double Fourier series, and truncated double Fourier series, and integration of the initial value problem for the spectral amplitudes results in steady states which agree qualitatively with those of previous experimental and theoretical investigations. Calculations are presented at two levels of truncation for a wide range of Prandtl numbers and a moderate range of horizontal Rayleigh numbers and top temperatures. For sufficiently large gravitational stability, a single asymmetric convection cell develops. Its intensity and asymmetry increase markedly with increasing horizontal Rayleigh number, decrease with increasing top temperature, and respond very slightly to changes in Prandtl number. Dissert. Abstr.

N68-23513*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ANALYSIS OF THREE-FLUID, CROSSFLOW HEAT EXCHANGERS
Noel C. Willis, Jr. Washington May 1968 114 p refs
(NASA-TR-R-284) CFSTI: HC $3.00/MF $0.65 CSCL 13A

The detailed behavior of three-fluid, crossflow heat exchangers has been investigated. The equations governing the two-dimensional temperature distributions of the three fluids have been derived and nondimensionalized. Performance characteristics have been determined for a wide range of operating parameters for single-pass heat exchangers. The performance of two-pass heat exchangers for both cocurrent and countercurrent flow has been studied for selected operating conditions. Results have been presented graphically in terms of the temperature effectiveness of the two outer fluids as functions of heat-exchanger size for sets of fixed operating conditions. Nondimensional operating parameters have been defined which allow an efficient presentation of the large volume of performance data required to represent a practical range of operating conditions. Sample problems are included to illustrate the use of the performance graphs for design applications. Author

N68-23540*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE GEOS-2 HEAT PIPE SYSTEM AND ITS PERFORMANCE IN TEST AND IN ORBIT
29 Apr. 1968 30 p refs
(Contract NOw-62-0604-C)
(NASA-CR-94585; S2P-3-25) CFSTI: HC $3.00/MF $0.65 CSCL 13A

The GEOS-2 spacecraft is the first satellite to be equipped with a heat pipe as an integral part of the thermal design. The heat pipe, a device of extremely high effective thermal conductivity, is employed to minimize the temperature differences between transponders located in opposite quadrants of the spacecraft. Measured heat transfer rates through the pipe of as much as 64 watts, together with small temperature gradients on the outside of the heat pipe, are evidence of proper operation. Based on a period of observation of 60 days, transponder maximum and minimum temperatures show improvement over GEOS-1 performance. Author

N68-23584 Minnesota Univ., Minneapolis.
AN EXPERIMENTAL STUDY OF MASS TRANSPORT THROUGH THE HELIUM 2 FILM
Forrest Irving Glick (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-15

Measurements of mass transport rates for flow of liquid helium through the He II film have been made in an apparatus in which the film flow took place between an inner reservoir and an outer reservoir held at constant temperature. The reservoirs were separated by a stainless steel vacuum jacket. The height of the rim of the vacuum jacket above the equilibrium liquid level in the reservoirs, referred to as the barrier height, h_0, could be varied from 3 cm to 30 cm. Measurements under adiabatic conditions were made with the inner reservoir thermally isolated from the outer reservoir by seating a plug into the top of the vacuum jacket. With the plug raised isothermal conditions were maintained through the gas phase. Flow rates were inferred by monitoring the liquid level in the inner reservoir with a capacitor depth gauge. The measured values of the specific entropy deficit of the superfluid component of the helium, determined from the rise of the inner liquid level when the film was driven thermally at unsaturated transfer rates,

agreed within ±4% with accepted values of the specific bulk entropy in the temperature range 1.27°K to 2.02°K. Adiabatic and isothermal oscillations of the liquid levels were studied. Dissert. Abstr.

N68-23607*# Rensselaer Polytechnic Inst., Troy, N. Y. Aeronautical Engineering and Astronautics Dept.
PLANE-FLAME SIMULATION OF THE WAKE BEHIND AN INTERNALLY PROPELLED VEHICLE. PART 2: SIMULATION OF A SUBSONIC VEHICLE BY A HEAT SOURCE
John H. Skinner, Jr. (Ph.D. Thesis) Jul. 1967 34 p refs Supported in part by NASA
(Contract C-117-66)
(NASA-CR-94599; TR-AE-6705, Pt. 2; PB-177141) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The development of the flow field about an internally-propelled vehicle in steady motion at subsonic speed in a tube is analyzed by the method of characteristics. The vehicle is simulated by a heat source releasing heat at a constant rate and moving through an infinite duct at a constant subsonic velocity. Friction and heat transfer are accounted for, and the characteristic equations are integrated numerically employing a high-speed computer. In a vehicle-fixed frame of reference the induced flow field is initially steady, but friction and heat transfer soon cause it to become nonsteady. As time progresses, the nonsteady effects slowly decay and the flow field asymptotically approaches a steady state. Author (PB)

N68-23657# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering and Process Technology Div.
THE HARWELL HIGH PRESSURE HEAT TRANSFER LOOP
A. W. Bennett and R. K. F. Keeys Dec. 1967 45 p refs
(AERE-R-5145) HMSO: 8s

A detailed description is presented of the Harwell high pressure, stream-water heat transfer loop; this description is aimed at supplementing the information given in reports on individual experiments. The operating instructions for the loop are given in an appendix. Author

N68-23665# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
NONUNIFORM HEAT GENERATION EXPERIMENTAL PROGRAM Final Report
Apr. 1967 241 p refs
(Contract AT(30-1)-3238)
(BAW-3238-13; EURAEC-1846) CFSTI: HC $3.00/MF $0.65

The results of an experimental and analytical program to determine how irregular heat flow through reactor channels affects the operating conditions that cause critical heat flux are presented. Tubular specimens with four axial power shapes and annular specimens with five power configurations were tested, and the effort to correlate the experimental data with empirical and analytical models is reported. Critical heat flux conditions were run in uniform and nonuniform axial flux shapes at 1000, 1500, and 2000 psia pressures, 0.5, 1.5, and 2.5 lb/hr-ft^2×10^6 mass velocities, and 20, 50, 100, and 150°F inlet subcooling conditions. The tubular test sections were 0.446-inch ID tubes 72 inches long. The annular channels had 1.053-inch OD and 0.607-inch ID. The analysis presents observations regarding critical heat flux location and magnitude along with equations which evaluate the effect of operating parameters on critical heat flux, location and magnitude. NSA

N68-23668# Max-Planck-Institut fur Metallforschung, Stuttgart (West Germany). Institut fuer Sondermetalle.
ARRANGEMENT AND TESTING OF AN APPARATUS FOR HIGH-TEMPERATURE DIFFERENTIAL THERMAL ANALYSIS [AUFBAU UND ERPROBUNG EINER ANLAGE ZUR HOCH-TEMPERATUR-DIFFERENTIAL-THERMOANALYSE]
D. Roesch, H. L. Lukas, and H. Goretzki 1 Oct. 1967 38 p refs In GERMAN; ENGLISH summary Supported in part by Bundesmin. Wiss. Forsch.
(BMwF-FBK-67-86)

An apparatus suitable for high-temperature differential thermoanalysis has been set up. The samples are induction-heated, and the power is continuously altered by slow variations of the rated value of the control unit. The temperature of the sample is pyrometrically measured and electronically differentiated with respect to time. The resulting dT/dt (T)-diagrams are plotted by an x-y-recorder. The apparatus, now being used for investigations at 1000 to 2300°C, can be applied up to 3600°C. During testing of this device, investigations in the systems Mo-C and Cr-Nb were carried out. Author (NSA)

N68-23687* Lockheed Missiles and Space Co., Sunnyvale, Calif.
A STUDY OF THE EFFECTS OF ENVIRONMENTAL AND ABLATOR PERFORMANCE UNCERTAINTIES ON HEAT SHIELDING REQUIREMENTS FOR HYPERBOLIC ENTRY VEHICLES, VOLUME 1
L. F. Hearne, W. D. Coleman, J. M. Lefferdo, L. W. Gallagher, and J. H. Chin [1968] 264 p refs
(Contract NAS2-4219)
(NASA-CR-73224) CSCL 20M

Uncertainties in the aerothermal technology that strongly influence heat shielding requirements at hyperbolic speed were investigated by evaluating the sensitivity of thermal protection system weight for two configurations representing blunt and slender bodies. Uncertainties in both the thermal environment and ablator performance of the heat shield materials and a range of entry velocities and corridor positions were evaluated. Aerothermal environment prediction is considered in terms of vehicle trajectories, inviscid flow fields, radiative heat transfer, and convective heat transfer. In-depth response and surface conditions are discussed for a model for predicting material performance. Baseline heat shielding requirements are given for both nominal and perturbed packaging density for both the blunt vehicle and the slender vehicle. Radiation, transition, mass transpiration, surface emissivity, pyrolysis gas composition, sublimation temperature, char spallation, and coupling between all of these uncertainties are discussed for both vehicles. M.W.R.

N68-23693# Advisory Group for Aeronautical Research and Development, Paris (France).
GRAPHICAL METHODS IN AERODYNAMICS
Otto Lutz and Gisela Stoffers Nov. 1967 320 p refs
(AGARDograph-98) CFSTI: HC $3.00/MF $0.65

A survey of diagrams and graphical methods used in thermodynamics, especially those that are important in the field of jet propulsion; it is a result of an extensive literature search. Part I deals with changes of state, including the pressure-volume-temperature system, the enthalpy-temperature-entropy system, and diagrams where one of the coordinates depends on composition. Heat transfer processes are treated in Part II. Part III covers the pressure velocity diagram for ideal gases and new types of diagram valid, for example, for gases with varying specific heats. . . . Author

N68-23703*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
RADIATION TRANSPORT FOR BLUNT-BODY FLOWS INCLUDING THE EFFECTS OF LINES AND ABLATION LAYER, VOLUME 3
Jin H. Chin Dec. 1967 177 p refs
(Contract NAS2-4219)
(NASA-CR-73223) CFSTI: $3.00 CSCL 20M

Efficient numerical methods are developed for fully radiation-coupled inviscid blunt body flows. The spectral nature of radiation transport is treated in detail, using as many as 21 spectral regions and accounting for air and ablation vapor continua and 75 discrete atomic lines. A concept of line group equivalent width and average transmittance is introduced in a finite difference

formulation of radiation transport. This concept is used to account for line overlaps and to formulate the numerical procedures. The application of the numerical methods is described. The effects of environmental variables, of the numerical methods used, and of the uncertainties in radiative properties are discussed. The results demonstrate that the self-absorption and energy loss effects decrease the sensitivity of the heat fluxes to the changes in environmental variables and to the uncertainties in radiative properties. Author

N68-23724*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.

ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, 15 Oct. 1967–15 Jan. 1968

R. W. Harrison, ed. 2 Feb. 1968 40 p refs

(Contract NAS3-6474)

(NASA-CR-72383; GESP-1; QPR-11) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Fabrication of the T-111 Rankine system corrosion test loop was completed, the necessary alkali metal for loop filling was purified, and the partial pressure gas analyzer for the vacuum chamber was calibrated. Three advanced tantalum alloy thermal convection capsules were filled with lithium and two advanced tantalum alloy reflux capsules were filled with potassium, and spectrographic analyses were made of both these alkali metals. The loop EM pump was fabricated, and the Nb-1Zr surge tank for this lithium loop is nearly complete. M.W.R.

N68-23727# Ballistic Research Labs., Aberdeen Proving Ground, Md.

EXPLOSIVE MECHANISM OF THE HYDROGEN-OXYGEN REACTION NEAR THE SECOND IGNITION LIMIT

Arthur Cohen and Jack Larsen Dec. 1967 40 p refs

(BRL-R-1386; AD-667362)

An investigation of the H2-O2 explosion behind reflected shocks was performed under conditions of low temperature and high pressure. Simultaneous measurements of pressure, UV light transmission, and schlieren streak photographs of the shock reflection-reaction wave formation process were made. Pressure spikes, emission, and absorption maxima were observed at times which correspond to the initiation of the reaction wave. The delay to the initial UV absorption was between 70 and 90 percent of the reaction wave delay. Contrary to what has previously been reported, the pressure and temperature dependence of the delays to initial absorption and to the initiation of the reaction wave did not differ. The analysis used by Voevodski and Soloukhin for calculating reaction wave delays in undiluted H2-O2 mixtures gave good agreement with experiments in both Ar-diluted and undiluted mixtures. The apparent failure of the analysis at the lowest temperatures is attributed to limitations on shock tube test time. Author (TAB)

N68-23739# United Kingdom Atomic Energy Authority, Risley (England). Central Technical Services.

THE ACCURATE SOLUTION OF TRANSPORT THEORY PROBLEMS BY THE USE OF A NEW VERSION OF DIFFUSION THEORY

R. T. Ackroyd 1968 51 p refs Reprinted

(TRG-1568(R)) HMSO: 7s

Each group of a transport theory model is treated so that each group equation and its associated boundary conditions are replaced by spherical harmonic equations, of an odd order for the moments of the angular flux, and the associated boundary conditions for the moments. The moment equations and boundary conditions are then cast into a form with the appearance of a generalized version of multigroup diffusion theory. The even moments correspond to the group fluxes of diffusion theory in this analogy. The gradients of the even moments correspond to the net group currents of diffusion theory. At an interface the moments, i.e. the analogous group fluxes, are continuous, and if the scattering is isotropic the product of the gradient of an analogous group flux and the diffusion coefficient of diffusion theory is continuous. This method for transport theory calculations is illustrated by an analytical treatment of boundary transients at the interface of a core and reflector. Author

N68-23750 Kansas State Univ., Manhattan.

TURBULENT CONDENSATION IN A HORIZONTAL TUBE

Stanley Oscar Brauser (Ph.D. Thesis) 1966 106 p

Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-687

The purpose of this study was to make a theoretical and experimental analysis of the condensation heat transfer rate for a pure vapor condensing turbulently within a horizontal tube while in the annular flow regime. A theoretical relationship for the condensation heat transfer coefficient was developed. The Prandtl power law was assumed for the vapor velocity distribution and a parabolic distribution for the condensate velocity profile. An additional analysis was made in which parabolic–parabolic velocity distributions were assumed. The experimental portion consisted in obtaining condensation heat transfer data and in making a photographic study of the turbulent condensation process.

Dissert. Abstr.

N68-23812# Columbia Univ., New York. Dept. of Chemical Engineering.

THERMODYNAMICS OF THE SYSTEM POTASSIUM/MERCURY

Charles R. La Mantia and Charles F. Bonilla 1 Sep. 1967 41 p refs Presented at 4th Symp. on Thermophys. Properties, Standing Comm. Paper, College Park, Md., 1–4 Apr. 1968 Submitted for publication

(Contract AT(30-1)-2660)

(CU-2660-34; CONF-680403-1) CFSTI: HC $3.00/MF $0.65

Experimental measurements were made of the total vapor pressure of potassium amalgams and the emf of potassium amalgam concentration cells, both as functions of temperature and of amalgam composition. Vapor pressure measurements were made at twenty compositions, including pure mercury, at pressures up to 10 atmospheres. Emf data were obtained for six compositions between mercury mole fractions of 0.10 and 0.55 at temperatures up to 500°C. From these data, the pure component vapor pressure and P–V–T data, and a model for the interaction of the gas species, the following thermodynamic properties were calculated as functions of composition along the saturation curves at pressures of 1/2, 1 and 2 atmospheres: mercury and potassium activities in the liquid amalgams; differential heat of vaporization; liquid heat of mixing; composition of the vapor in equilibrium with the amalgam; and equilibrium vapor compressibility factor.

Author (NSA)

N68-23823# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD FOR CALCULATING ENTROPY OF SOLID INORGANIC COMPOUNDS BY THE TEMPERATURE OF THE PHASE TRANSITION [METOD RASCHETA ENTROPII TVERDYKH NEORGANICHESKIKH SOYEDINENIY PO TEMPERATURE FAZOVOGO PEREKHODA]

L. I. Ivanova *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 61–67 refs (See N68-23814 13-15)

The entropy of elements at $0.3T_{per}$, where T_{per} is the temperature of the first transition of the phase, e.g. melting, volatilization, or transformation, in the majority of cases depends on the position of the element in the periodic table and above $0.3T_{per}$ on the difference $(S_{T_{per}} - S_{0.3T_{per}})$ and $1/N(S_{T_{per}} + S_{0.3T_{per}})$ where N is the number of atoms in the molecule of the compound. A comparison of the entropy of inorganic compounds shows a definite relation between the arrangement of curves $S = f(T:T_{per})$ and the position of the elements making up the given compound in the periodic table. Author

N68-23828# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT CAPACITY OF LEAD CONCENTRATES AND AGGLOMERATE AT HIGH TEMPERATURES [TEPOLYEMKOST' SVINTSOVYKH KONTSENTRATOVI AGLOMERATA PRI VYSOKIKH TEMPERATURAKH]

S. G. Bratchikov *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 105–108 refs (See N68-23814 13-15)

In the execution of heat engineering calculations it is necessary to know the heat capacities of multicomponent materials containing lead (lead concentrates, lead agglomerate). Changes of enthalpy ΔH during heating and of the heat capacity of these materials at temperatures from 273 to 373–1173°K were studied. Measurements were made by an adiabatic calorimeter. Results of the investigation provide equations for the calculation of average specific heat capacity, depending on temperature. Author

N68-23843*# Virginia Polytechnic Inst., Blacksburg.

A STUDY OF THE APPLICATION OF MICROWAVE TECHNIQUES TO THE MEASUREMENT OF SOLID PROPELLANT BURNING RATES Progress Report, 1 Sep. 1966–31 Aug. 1967

Henry L. Wood and Walter F. O'Brien, Jr. Apr. 1968 170 p refs

(Grant NGR-47-004-024)

(NASA-CR-66627) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Introductory data and a literature survey are presented on techniques for measuring the burning rate of solid rocket propellants. A method, involving the transmission of microwaves through the unburned solid propellant, is demonstrated wherein a reflection of the microwaves occurs at the burning surface, and as the propellant burns, the reflected signal changes phase. The reflected signal is then compared with a portion of the transmitted signal to obtain burning rate information. The experimental apparatus, test procedures, data reduction techniques, and resultant data are reported for simulated and atmospheric tests as well as the firing of test rocket engines. E.J.S.

N68-23862*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A METHOD OF PREDICTING HEAT TRANSFER COEFFICIENTS IN THE COOLING PASSAGES OF NERVA AND PHOEBUS-2 ROCKET NOZZLES

Maynard F. Taylor Washington 1968 13 p refs Presented at the 4th Joint Propulsion Specialists Conf., Cleveland, 10–14 Jun. 1968

(NASA-TM-X-52437) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The generally accepted methods of predicting heat-transfer coefficients often give values which are in poor agreement with the measured coefficients for single phase hydrogen flowing through straight symmetrically heated circular tubes for the extreme conditions encountered in the NERVA or Phoebus-2 nozzle. A thorough study of the 4600 experimental heat-transfer coefficients for hydrogen flowing through straight tubes is made which results in an equation which predicts coefficients with acceptable accuracy over a wide range of conditions. The prediction equation for straight tubes is modified to predict coefficients for hydrogen on both the "swept concave surface" and the "upswept convex surface" of curved symmetrically heated circular tubes. Without further modification the equation predicts heat-transfer coefficients which are in good agreement with values measured in asymmetrically heated noncircular channels simulating the throat region of the NERVA and Phoebus-2 nozzles. These tests were run under the actual anticipated heat flux, pressure, temperature, and flow rate. The prediction equations are recommended for use in predicting heat-transfer coefficients in the cooling passages of the actual NERVA and Phoebus-2 rocket nozzles. Author

N68-23873# Brookhaven National Lab., Upton, N. Y.

HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW Bimonthly Technical Progress Review, Volume 5, No. 5

Oct. 1967 48 p

(BNL-50089) CFSTI: HC $3.00/MF $0.65

Information is presented on research and development programs devoted to high temperature liquid metal technology including materials development, corrosion and mass transfer, heat transfer, fluid dynamics, instrumentation, purification, component development, physical properties, thermodynamics, chemical analysis, and power systems. NSA

N68-23907# Watervliet Arsenal, N. Y. Benét Labs.

THERMAL CONTROL OF ELECTROPLATING TANK BY A HEAT EXCHANGER

Peter W. Jasinski and Chi-Neng Shen Jan. 1968 27 p refs

(WVT-6806; AD-667366)

The system of non-linear partial differential equations which describe the dynamics of the condensation heat exchanger is solved by a perturbation Laplace transformation technique. The temperature control feedback loop was developed, using the steam temperature as the control variable. The stability of this closed loop is examined with the Nyquist criterion. Author (TAB)

N68-23964 Boeing Co., Seattle, Wash.

INVESTIGATION OF TURBULENT HEAT TRANSFER AT HYPERSONIC SPEEDS. VOLUME 1: ANALYTICAL METHODS Final Report, Mar. 1965–Mar. 1967

Richard T. Savage and Carl L. Jaeck Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Dec. 1967 135 p refs

(Contract AF 33(615)-2372)

(D2-113531; AFFDL-TR-67-144, V. 1; AD-667798)

The report presents a combined analytical and experimental investigation of turbulent heat transfer on basic and composite configurations at hypersonic speeds. The analytical results are presented in Volume I. Two analytical approaches are presented: the rho sub r mu sub r method and the turbulent nonsimilar boundary layer method. The rho sub r mu sub r method, which is derived from the boundary layer momentum and energy integral equations, is recommended for predicting turbulent heating rates. Effects of dissociation, pressure and wall temperature gradients, three-dimensional flow, and nose bluntness are included. Simplified methods for making turbulent heating estimates using slide-rules or desk calculators are also presented. The computation of heating rates on a typical reentry configuration in flight and the extrapolation of test data from ground test facilities to flight are described. The turbulent nonsimilar boundary layer approach offers several advantages over previous methods, and is recommended for specific parametric studies of turbulent flows. Calculations made using this method were restricted to ideal gases. Modifications can be made to include real-gas effects. Author (TAB)

N68-23988*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

COMPARTMENT VENTING AND PIPE FLOW WITH HEAT ADDITION

H. G. Struck and John A. Harkins 23 Apr. 1968 105 p refs

(NASA-TM-X-53734) CFSTI: $3.00 CSCL 20M

One-dimensional quasi-steady theory is used to develop an engineering method to determine the time-dependent pressure in vented launch-vehicle compartments during the first few minutes of the ascending flight. The basic program is set up for the CDC-3200 digital computer which can handle presently only up to N = 5 compartments where the inner compartments must have only one connecting orifice and the last compartment can have up to NV = 5 orifices venting into the atmosphere. Furthermore, the compartments have to be placed in series. Though the compartment

and orifice number can be raised indefinitely, it is advisable to restrict the number to as few as possible to keep the computation time low. The basic program has been extended to offer combinations of compartment and connecting orifices. Compartment leaks and their accompanying coefficients, as well as venting through a duct of varying cross section, have been included. The effect of heating or cooling the duct flow can also be computed. Author

N68-23994# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
EFFECT OF MODULATION ON THE ONSET OF THERMAL CONVECTION
Giulio Venezian Mar. 1968 25 p refs
(Contract Nonr-220(35))
(Rept.-97-15; AD-667476)

The stability of a horizontal layer of fluid heated from below is examined when, in addition to a steady temperature difference between the walls of the layer, a time-dependent sinusoidal perturbation is applied to the wall temperatures. Only infinitesimal disturbances are considered. The effects of the oscillating temperature field are treated by a perturbation expansion in powers of the amplitude of the applied field. The shift in the critical Rayleigh number is calculated as a function of frequency, and it is found that it is possible to advance or delay the onset of convection by time modulation of the wall temperatures. Author (TAB)

N68-24012# General Electric Co., Schenectady, N. Y. Research and Development Center.
A MODEL FOR THE CANDLE-LIKE BURNING OF POLYMERS
Frederick J. Martin Jan. 1967 30 p refs
(Rept.-67-C-006)

Polymers have been burned in a candle-like manner in a slowly rising gaseous atmosphere and the limiting ratio of oxygen to inert gas in the atmosphere required to sustain steady burning was determined. This ratio n_{ox}/n_i, is approximately a linear function of the heat capacity of the inert gas for atmospheres of Ar, N_2, or CO_2 with oxygen. The n_{ox}/n_i values determined in He/O_2 do not obey this relationship; they are higher by 50% or more than corresponding values in Ar/O_2. A model is developed in which the stability of the leading edge of the flame is critical. It is proposed that n_{ox}/n_i ratios must exceed limiting value to maintain the necessary temperature and stability in this critical region. If assuming that for a given polymer the minimum flame temperature, stoichiometry of flame reactions, and molar heat loss from the critical region are the same in all inert gases except He, the steady-flow energy equation leads to the experimentally observed linear relationship between n_{ox}/n_i and the heat capacity of the inert gas. For observed values of n_{ox}/n_i the model yields plausible values of flame temperature and molar heat loss. The anomalously high n_{ox}/n_i values in He/O_2 are believed to result from higher rates of heat loss from the critical flame region. Author

N68-24031 Minnesota Univ., Minneapolis.
TEMPERATURE HISTORY AND FLUID SOLID INTERFACE EFFECTS ON HEAT CONDUCTION IN CERTAIN LIQUIDS
Jules Jean Charles Picot (Ph.D. Thesis) 1966 132 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-873

Transient-state heat conduction in non-deforming materials is studied theoretically and experimentally for cases where temperature changes are very rapid. For situations in which the time scale of temperature change is of the same order of magnitude as the relaxation times for the molecular energy transport process, it is shown that the constitutive equation for energy transport must be of the hereditary type. The energy flux is then a function of the temperature history of the fluid. Experiments were carried out on various materials. The experiments show that hereditary effects are not important in heat conduction: relaxation times of the energy transport process are less than those which can be detected by the experiments (10^{-5} secs.). In some of the experiments, particularly those in a liquid crystalline material, effects were noted which cannot be explained by Fourier's Law for a homogeneous medium. These effects are attributed to molecular orientation at the solid-liquid interface. As evidence for the existence of an oriented region may be cited the observed effects of an electric field and temperature on the apparent thermal conductivity near the interface. These results indicate that there should be an easily detectable coupling between energy and momentum transport in liquid crystalline materials. Dissert. Abstr.

N68-24089 General Electric Co., Philadelphia, Pa. Missile and Space Div.
MOMENT AND DISCRETE ORDINATE METHODS IN RADIATIVE TRANSFER PROBLEMS
R. T. Liner, Jr. Dec. 1967 30 p refs
(Contract N60921-7164)
(R67SD68; AD-667225)

A recently introduced modification of the standard moments method, applicable to radiative transfer problems in planar, radiating, non-scattering media without polarization effects, is examined for the general N-th order approximation. The modification is essentially a canonical transformation of the standard moment equations. It is shown that the transformed system is not only equivalent, but essentially identical, to the discrete ordinates method. The transformation is useful in that it provides more insight into the relationship between the moments method and the discrete ordinates method. Author (TAB)

N68-24123# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THERMOCOUPLES AND SURFACE TEMPERATURE MEASUREMENT
A. J. Otter Mar. 1968 21 p refs
(AECL-3062) CFSTI: HC $3.00/MF $0.65

Details are given on the use of thermocouples for surface temperature measurement. The methods of attaching the thermocouples to a surface are described, including installation of a permanent thermocouple, which gives a continuous history of surface temperature, and temporary thermocouple, which consists of a sensing probe in mechanical contact with the surface to obtain spot readings. Several ways of forming a thermocouple junction for accurate temperature measurement are presented. The methods for making spot check measurements with a probe are discussed, and the procedures for reducing errors associated with probe measurements are described. The causes of measurement errors are delineated, and mathematical methods for determination of these errors are given for various conditions. B.S.D.

N68-24130# European Space Technology Center, Noordwijk (Netherlands).
A 'FAST' TRANSIENT METHOD OF DETERMINING INFRA-RED OUTPUTS IN SPACE CHAMBER
L. A. Husain Paris ESRO Dec. 1967 24 p ref
(ESRO-TM-110(ESTEC)) CFSTI: HC $3.00/MF $0.65

A technique is presented for the detection of short-lived infra-red sources which may be created in a solar simulation space chamber. Although amenable to calibration, for the purposes of detection only, the technique is entirely independent of the level of solar beam intensity and uncertainties in all other parameters including the radiation characteristics of coatings. Author (ESRO)

N68-24136 Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Institut fuer Chemische Raketenantriebe.
VARIABLES OF STATE AND CHARACTERISTICS FOR ISENTROPIC DISCHARGE PHENOMENA OF WATER,

STARTING WITH SATURATION [ZUSTANDSGROESSEN UND KENNWERTE FUER ISENTROPE AUSSTROEMVORGAENGE VON WASSER AB SAETTIGUNGSZUSTAND]
Hans Baudisch Mar. 1968 187 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-11; DVL-694) CFSTI: $3.00

The tables presented in this report contain the thermodynamic values of isentropic change of state for water in the two-phase region starting from the saturation line down to 0.01 at. The variables have been computed in the pressure range from 5–100 at in equal pressure intervals of 5 at and in the range from 100–170 at in intervals of 10 at. Assuming a one-dimensional flow and a known saturation pressure, the dimensions of a discharge nozzle may be determined by interpolation of the calculated values for an isentropic discharge. Author

N68-24138# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A NOTE ON WIDOM'S HOMOGENEITY ASSUMPTION
G. Stell Mar. 1968 8 p refs
(TH/68/11) CFSTI: HC $3.00/MF $0.65

A variant of Widom's homogeneity assumption is examined that permits consideration of critical indices that have different values above and below the critical temperature. Author

N68-24145 Pennsylvania State Univ., University Park.
HEAT AND MASS TRANSFER IN LIQUID-LIQUID SPRAY TOWERS
Eugene Joseph Greskovich (Ph.D. Thesis) 1966 164 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-1927

Heat transfer, mass transfer, and simultaneous heat and mass transfer were carried out in a spray tower 6 inches I.D. with an effective height of 10 feet. The systems used were kerosene (Kensol 17)-water and kerosene-water-methylethyl ketone (MEK) for heat and mass transfer, respectively. Four diffuser elements were employed during these investigations and the dimensions are as follows: (1) 278 1/8-inch holes, (2) 362 1/16-inch holes, (3) 727 1/32-inch holes, and (4) 326 1/64-inch holes. For the first three diffusers, the number of theoretical heat transfer stages during free rise studies varied from 1.3 to 3.8 at dispersed phase (kerosene) hold-ups of approximately 2.2 to 33.7 per cent. Heat transfer was from the kerosene. For the same investigations the volumetric heat transfer coefficients ranged from 100 to 1530 Btu/hr.ft^{3}.°F while the overall film coefficients varied from 4.4 to 18.2 Btu/hr.ft^{2}.°F. Dissert. Abstr.

N68-24173# Boeing Co., Seattle, Wash. Aerospace Corp.
INVESTIGATION OF TURBULENT HEAT TRANSFER AT HYPERSONIC SPEEDS. VOLUME 3: THE LAMINAR-TURBULENT $\rho_r\mu_r$ MOMENTUM INTEGRAL AND TURBULENT NONSIMILAR BOUNDARY LAYER COMPUTER PROGRAMS Final Report, Mar. 1965–Mar. 1967
Richard T. Savage, Carl L. Jaeck, and James R. Mitchell Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Dec. 1967 232 p refs
(Contract AF 33(615)-2372)
(D2-113531-3; AFFDL-TR-67-144, V. 3; AD-667804)

The report presents a combined analytical and experimental investigation of turbulent heat transfer on basic and composite configurations at hypersonic speeds. Computer programs incorporating the analytical methods described are presented in Volume III. The two heat-transfer prediction methods programmed are the laminar-turbulent rho sub r mu sub r momentum integral method and the turbulent nonsimilar method. This volume of the report describes the numerical method and presents flow charts, program listings, input forms, and a description of the output for each program. The programs are written in Fortran IV language for operation on the IBM 7094. Author (TAB)

N68-24190# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Institut fuer Luftstrahlantriebe.
APPROXIMATION POLYNOMIALS FOR CALORIC VARIABLES OF STATE OF VARIOUS GASES [NAEHERUNGSPOLYNOME FUER KALORISCHE ZUSTANSGROESSEN VERSCHIEDENER GASE]
Gerhard Rimpel and Alfons Meffert Mar. 1968 65 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-19; DVL-735) CFSTI: HC $3.00/MF $0.65

For use in digital computers approximation polynomials are given for the temperature-dependence of spec. heat at constant pressure, of enthalpy, and of entropy at a pressure of 1 bar in the range of 200°K≤T≤5000°K for the gases CO, CO_2, F, F_2, H_2, HF, H_2O, N, N_2, NO, O, O_2, and OH. Complementarily for calculation of gas-engine-processes polynomials of the afore-mentioned variables of state of non dissociated combustion gases (air included) for four fuels are quoted in the temperature range of 200°K≤T≤2000°K. Author

N68-24208# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
INTEGRAL METHOD FOR THE CALCULATION OF HEAT TRANSFER IN LAMINAR SUPERSONIC SEPARATED FLOWS
Arnan Seginer and Josef Rom Nov. 1967 42 p refs
(Contract F61052-67-C-0033)
(TAE-78; SR-5; AD-667200)

The problem of heat transfer in laminar supersonic separated flows is treated by an extension of the Crocco–Lees mixing theory to the case of non-adiabatic flows. The interaction between a viscous and dissipative layer near a body surface, or in its wake, and an outer isentropic flow is considered to be the main mechanism determining the flow conditions. The basic integral boundary layer equations are used after being rewritten to include properly defined average velocity, temperature and total enthalpy and also mixing rate, friction, heat transfer and enthalpy functions. It is shown that for zero pressure gradient the equations can be reduced to those of a corresponding constant properties boundary layer and can be solved in a closed form exact solution. When a pressure gradient is present such a reduction of the equations is still a good approximation. In this case these approximate equations are solved numerically. It is also shown that for a known distribution of free stream velocity, consistent with similar solutions, the present method also enables exact numerical solutions. This method is then applied to a separated flow also over a backward facing step, where characteristic parameters of the flow are obtained from experimental and from 'exact' solution of attached boundary layer with heat transfer. TAB

N68-24228# Cambridge Univ. (England). Cavendish Lab.
GROWTH OF BURNING TO DETONATION IN LIQUIDS AND SOLIDS Annual Summary Report, Nov. 1966–1967
F. P. Bowden, J. E. Field, P. G. Fox, and M. M. Chaudhri Dec. 1967 20 p refs
(Grant AF-EOAR-67-03)
(AFOSR-68-0572; AD-667216)

The initiation and propagation of explosion in liquids and solids was studied with special reference to the role played by discontinuities in promoting sensitivity, and the deflagration, detonation transition. The electronic structures of a range of inorganic fulminates were determined, and it is concluded that while sodium, potassium and thallous fulminates are ionic, the mercury salt is covalent. The slow decomposition of various azides was shown to take place almost entirely at the surface and not at internal defects. Author (TAB)

N68-24236*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
FEASIBILITY INVESTIGATION OF A LOW-TEMPERATURE, VARIABLE INFRARED SOURCE. HORIZON DEFINITION STUDY

Joseph S. Titus and Roger N. Schmidt Mar. 1968 97 p refs
(Contract NAS1-6010)
(NASA-CR-66614) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A requirement for a variable temperature, highly accurate infrared source has been identified for the Horizon Definition Study. A survey of the state of the art indicated that no system was available to satisfy this requirement. An analysis was performed, subassembly tests conducted, and a system designed and fabricated to verify the analysis. Preliminary test results indicate that, although problem areas still exist in the implementation of this device, the requirements can be met. Author

N68-24267*# IIT Research Inst., Chicago, Ill. Dept. of Mechanical and Aerospace Engineering.
LIQUID DROPLET EVAPORATION IN STAGNANT HIGH PRESSURE AND HIGH TEMPERATURE ENVIRONMENT Final Report
T. P. Torda and Robert Matlosz May 1968 47 p refs
(Grant NGR-14-004-006)
(NASA-CR-72373) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Investigated were experimental histories for liquid droplets vaporizing in a subcritical, critical, and supercritical environment. Histories have been obtained for 1800μ diameter n-Pentane drops vaporizing in nitrogen gas environment. The gas environment temperature was 850°R and the pressure varied from 200psi to 1400psi. Time histories of the temperature and the size of the droplet are recorded. The vaporization histories are compared with existing analytical methods for the prediction of the droplet vaporization. Author

N68-24278 Maryland Univ., College Park.
THE MECHANISM OF MASS TRANSFER IN SINGLE OSCILLATING DROPS IN EXTRACTION SYSTEMS
William Ben Ellis (Ph.D. Thesis) 1966 222 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-2002

A model is developed which describes the mechanism of material transport within single oscillating drops moving in a liquid–liquid extraction system. A numerical solution is presented for the mass transfer problem for the drop in which the transport is promoted by oscillation induced and sustained turbulence in a thin region near the interface. The solution produces a graphical representation of the dependence of dispersed phase Sherwood number, on dimensionless time, and this time dependence is a function of Reynolds number, Schmidt number, Weber number, the ratio of viscosities in the two phases, and the ratio of densities in the two phases. It is proposed that the effect of oscillatory mixing in the drop can be expressed by a series of periodic instantaneous perfect mixings. Fifty-three single drop mass transfer data, obtained from five aqueous–organic extraction systems, are analyzed to determine the dependence of the apparent period between perfect mixings on system parameters. Dissert. Abstr.

N68-24285 Iowa State Univ. of Science and Technology, Ames.
HEAT AND MASS TRANSFER COEFFICIENTS IN MICROWAVE FREEZE-DRYING
James Bryan Trecek (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-2688

The purpose of this investigation was to develop a method of determining and correlating microwave heat transfer data based on theoretical considerations, which would be analogous to the well known conduction, convection, and radiation heat transfer coefficient correlations. In particular, microwave heating was studied in connection with the interphase mass transfer process of freeze-drying, with reference to its use as a method for increasing the rate of water recovery from biological wastes in a life support system in outer space. Coefficients for microwave heat transfer were experimentally determined for two sample materials: distilled water ice, and a ternary mixture containing 5.0% by weight of carbon and 5.0% by weight of sodium chloride in distilled water ice. The ternary mixture provided a relatively high microwave absorbing material to check the proposed correlation. Dissert. Abstr.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-23230 Texas A&M Univ., College Station.
ANALYTIC AND MONTE CARLO DISTRIBUTION THEORY FOR PERT
Larry Joel Ringer (Ph.D. Thesis) 1966 61 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 order No. 67-4719

This study is concerned with the distribution of the critical time in PERT analysis, a technique used in the planning and control of the activities required to accomplish a desired goal. Techniques are introduced for determining estimates of the distribution of the project completion time as well as its expected value, μ, and variance σ^2. The techniques presented consist of two phases: the first being algorithms to reduce the original PERT network to an equivalent network consisting of fewer activities, the second being Monte Carlo sampling schemes for estimating the mean, variance, and cumulative distribution function. In addition, a model is presented which has dependence among the activity completion times. Dissert. Abstr.

N68-23457# Advisory Group for Aerospace Research and Development, Paris (France).
INFORMATION BULLETIN NUMBER 68-1
Jan. 1968 40 p refs
(AGARD-IB-68/1) CFSTI: HC $3.00/MF $0.65

This bulletin contains a summary of research and development activities, a listing of lecture series, a summary of AGARD publications, the calendar of meeetings for 1968, and reports and projections by the following AGARD panels: aerospace medicine, avionics, flight mechanics, fluid dynamics, guidance and control, propulsion and energetics, structures and materials, and technical information. K.W.

N68-23524*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
EXPERIMENT S046: VISIBLE RADIATION POLARIZATION MEASUREMENTS, PHASE C Final Report, 1 Jul. 1967–31 Jan. 1968
Paul A. Lang and T. A. Hariharan Jan. 1968 41 p
(Contract NAS9-7267)
(NASA-CR-65953) CFSTI: $3.00 CSCL 05A

Summarized are results of research conducted under a program designed to measure visible radiation polarization. Efforts including scientific and technical support; supporting studies and project management focusing on defining preliminary design criteria for the experiment; and specifications and management plans for the flight hardware phase of the program; are reported. S.C.W.

N68-23536# Advisory Group for Aerospace Research and Development, Paris (France).
THE LAYOUT OF TECHNICAL REPORTS
A. H. Holloway, ed. Jan. 1968 21 p *Its* Specification 1, Revision 1
CFSTI: HC $3.00/MF $0.65

Recommendations by Documentation Committee for size, markings on cover and title page, contents list, pagination, notation, abstract, list of references, tables, illustrations, appendices and index cards in technical reports. Notes are included on the application of the recommendations to bound books and to periodicals. Appendices give a proposal by I.S.O. for minimum biographical references, and cataloguer's notes. Author

N68-23643*# California Univ., Berkeley. Space Sciences Lab.
ANNUAL CONFERENCE OF EPISCOPAL CATHEDRAL DEANS
10 Apr. 1967 106 p refs Proc. held 7–10 Apr. 1967
(Grant NsG-243)
(NASA-CR-94594) CFSTI: HC$3.00/MF$0.65 CSCL 05F

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4. SOCIAL SIGNIFICANCE OF TECHNICAL ADVANCE I. R. Hoos p 40–64 refs (See N68-23647 13-34)

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6. THE PRESENT DAY VIEW OF THE PHYSICAL UNIVERSE H. F. Weaver p 79–101 (See N68-23649 13-30)

N68-23644*# California Univ., Berkeley. Space Sciences Lab.
THE IMPACT OF MODERN SCIENCE AND TECHNOLOGY ON SOCIETY
Samuel Silver *In its* Ann. Conf. of Episcopal Cathedral Deans 10 Apr. 1967 p 1–13 (See N68-23643 13-34)

An attempt is made to dispel the conflict between science and religion by first defining the particular roles of each and then by showing that science and technology are natural expressions of man's creativity and that religion can provide a frame of reference of a philosophical perspective for man's position in the scheme of things. New findings in several fields of science are then discussed from the viewpoint of their impact on man's thinking and philosophical base. These include recent knowledge in the fields of space research and exploration, molecular biology, chemical evolution, and systems analysis. R.N.A.

N68-23647*# California Univ., Berkeley. Space Sciences Lab.
SOCIAL SIGNIFICANCE OF TECHNICAL ADVANCE
Ida R. Hoos *In its* Ann. Conf. of Episcopal Cathedral Deans 10 Apr. 1967 p 40–64 refs (See N68-23653 13-34)

The inroads of computers into practically every aspect of the business and government community, society's growing dependence on them, and their impact on society's attitudes toward and sense and use of time are considered. Various examples of the depersonalized effects of computer applications to the educational system are given. Mass media effects on man by overloading his sensory capacity and his resulting inability to react appropriately and to view tragedy as being matter-of-fact are discussed. Subliminal persuasion and "brainwashing" aspects of mass media are also treated. Finally, the discussion turns to the effects of technology on morality and ethics and the problem of invasion of privacy in a computer-centered society. R.N.A.

N68-23648*# California Univ., Berkeley. Space Sciences Lab.
ETHICS OF LARGE SYSTEMS
C. West Churchman *In its* Ann. Conf. of Episcopal Cathedral Deans 10 Apr. 1967 p 65–78 (See N68-23643 13-24)

Recent developments in operations research and management science, the method of systems analysis and its applications, and some of the philosophical problems arising from this field are discussed. R.N.A.

N68-23816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECTIVENESS OF SYSTEMS OF MINING AND METHODS OF EXTRACTION OF VERY THIN VEINS [EFFEKTIVNOST' SISTEM RAZRABOTKI I SPOSOBOV VYYEMKI VES'MA TONKIKH ZHIL]
P. A. Makhin *In its* News of Inst. of Higher Learning: Nonferrous Met. 29 May 1967 p 7–14 refs (See N68-23814 13-15)

A study aimed at increasing the efficiency of mining rare and noble metals from very thin veins of ore, and at the same time achieving cost reduction is described. A formula for an index of relative efficiency is presented. Concluded is that the selective methods in preference to bulk method of mining achieves a smaller net cost of production. Author

N68-23886# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1969, PART 2
Washington GPO 1968 434 p Hearings before Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess., 5, 19, and 26 Mar. and 23 Apr. 1968
GPO: HC$1.50; CFSTI: MF$0.65

Discussed is a bill to authorize appropriations to the NASA administration for research and development, construction of facilities, and administrative operations during fiscal year 1969. G.G.

N68-23905# Congress. House. Committee on Appropriations.
INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, APPROPRIATIONS FOR 1969
Washington GPO 1968 1373 p Hearings before Subcomm. of the Comm. on Appropriations, Part 2, 90th Congr., 2d Sess.

The hearings on NASA's appropriation requests for fiscal year 1969 are reported. Guidelines for the 1969 program and budget estimates are outlined for both manned and unmanned space missions. The utilization of space technology in industrial processes is discussed, as is NASA's relationships with other governmental agencies and with foreign nations. The effects of a lower spending level in FY 1969 are considered in terms of specific NASA programs as well as in terms of its impact on the overall national economy. E.J.S.

N68-23931# Institute for Defense Analyses, Arlington, Va.
OAR RESEARCH APPLICATIONS CONFERENCE, 1968, VOLUME 1
21 Mar. 1968 376 p refs 3d Ann. Proc. held 21 Mar. 1968
(OAR-68-001, V. 1; AD-666800) CFSTI: HC$3.00/MF$0.65

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1. PRINCIPLES AND APPLICATIONS OF THE PLASMA DISPLAY PANEL D. L. Bitzer and H. G. Slottow (Ill. Univ.) 43 p refs (See N68-23932 13-08)

2. DETECTION AND IDENTIFICATION OF MICROORGANISMS BY GAS CHROMATOGRAPHY J. R. Gould (Syracuse Univ.) 39 p refs (See N68-23933 13-04)

3. THE OPTIMAL SOLUTION OF A TACTICAL PURSUIT-EVASION PROBLEM R. F. Vachino, D. H. De Does, J. F. Schaefer, and G. Cook (Air Force Acad.) 11 p refs (See N68-23934 13-34)

4. RADAR INVESTIGATION OF CLEAR-AIR TURBULENCE K. R. Hardy (Air Force Cambridge Res. Labs.) 16 p refs (See N68-23935 13-20)

5. REENTRY COMMUNICATION STUDIES AND RECENT FLIGHT TEST RESULTS J. L. Poirier (Air Force Cambridge Res. Labs.) 14 p (See N68-23936 13-07)

6. AN INVESTIGATION OF HYPERSONIC AERODYNAMICS AT HIGH ALTITUDES S. M. Bogdonoff (Princeton Univ.) 20 p refs (See N68-23937 13-01)

7. POLYGONAL AND SWEPT-BACK PLATES WITH CUT-OUTS AND COLUMN SUPPORTS P. M. Quinlan (Univ. Coll.) 78 p refs (See N68-23938 13-32)

8. OBSERVATION AND FORECASTING OF SOLAR PROTON EVENTS J. P. Castelli (Air Force Cambridge Res. Labs.) 25 p refs (See N68-23939 13-29)

9. SUPERCONDUCTING METALLURGY B. T. Matthias (Calif. Univ.) 11 p refs (See N68-23940 13-26)

10. HIGH ENERGY DENSITY ELECTROCHEMICAL CELLS L. A. King, A. D. Brown, Jr., and F. H. Frayer (Air Force Acad.) 17 p refs (See N68-23941 13-03)

11. LASERS FROM II–VI COMPOUNDS D. C. Reynolds (Aerospace Res. Labs.) 22 p refs (See N68-23942 13-26)

12. ELECTRON BEAM FLUORESCENCE STUDIES AND THEIR APPLICATION TO GAS DYNAMIC RESEARCH E. P. Muntz (GE) 25 p refs (See N68-23943 13-12)

13. ESTIMATING THE DATE OF ONSET OF THE RAINY SEASON IN SOUTHERN SOUTH VIETNAM I. A. Lund (Air Force Cambridge Res. Labs.) 26 p refs (See N68-23944 13-20)

14. IMPROVED ZIRCONIA REFRACTORIES FOR HYPERSONIC WIND TUNNEL STORAGE HEATERS L. L. Fehrenbacher (Aerospace Res. Labs.) 23 p refs (See N68-23945 13-18)

N68-23934# Air Force Academy, Colo. Frank J. Seiler Research Lab.

THE OPTIMAL SOLUTION OF A TACTICAL PURSUIT-EVASION PROBLEM

Rinaldo F. Vachino, Dirk H. deDoes, John F. Schaefer, and Gerald Cook *In* Inst. for Defense Analyses OAR Res. Appl. Conf., 1968 Vol. 1 21 Mar. 1968 11 p refs (See N68-23931 13-34)

A study of tactical aircraft-missile engagements which focuses on determining optimum evasive tactics for an aircraft under attack by an enemy missile system is reported. The particular engagement examined is that of a tactical fighter attacked by a surface-to-air beam riding missile. Choice of this particular engagement was based on its applicability to the SA-2 evasion problem and the availability of computer simulation results for this type of engagement. Since the analysis of a realistic engagement between the aircraft and missile is extremely complex, the approach to this problem was first to analyze a simplified two dimensional model of an engagement in order to determine the applicability of modern optimization techniques and to gain insight and experience into digital computer programming of such a problem; secondly, to analyze a generalized (more realistic) two dimensional engagement; and finally, to analyze the complete three dimensional engagement. Results of efforts pertaining to the simplified two dimensional engagement are presented. Results include the establishment of a capability based on the use of a simplified and a generalized two dimensional model, to determine optimal evasion strategies for both present and future generation aircraft. S.C.W.

N68-24094# Army Edgewood Arsenal, Md.

WISWESSER LINE NOTATION MEETING

James P. Mitchell, ed. Jan. 1968 100 p refs Proc. of the Army Chem. Inform. and Data Systems Program, Edgewood Arsenal, Md., 6–7 Oct. 1966

(EASP-400-8; AD-665397)

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2. LOW-COST STORAGE AND RETRIEVAL OF ORGANIC STRUCTURES BY PERMUTED LINE NOTATIONS: SMALL COLLECTIONS J. K. Horner (Stanford Res. Inst.) p 25–33 refs (See N68-24096 13-34)

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15. THE FORMAL ANALYSIS OF NOTATION SYSTEMS J. Munz (Pa. Univ.) p 197–202 refs (See N68-24109 13-34)

N68-24095# Searle (G. D.) and Co., Chicago, Ill.

USE OF THE WISWESSER LINE NOTATION AT THE SEARLE LABORATORIES: MOTIVATION AND STATUS

Howard T. Bonnett *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 15–23 (See N68-24094 13-34)

Industrial use of the Wiswesser line notation as an information indexing and retrieval tool is illustrated by showing the structure of several chemical compounds. Operating experiences have indicated that some of the original rules require modification, and three bicyclic heterocyclic structures are included to show the effect of rule design under the old and a revised notation. In the old alphabetical file (written in 1954) these three compounds would appear in three different locations, whereas the new file would group the compounds together. A sample page is included to show the telephone-directory type of index that results from use of the Wiswesser notation; and, in addition to the notation and notation prefix, the laboratory from whence the compound originated, a four-digit classification code, country and type of literature indication, literature reference, and formula sheet number are included for each entry. Experiences with 125,000 compounds, primarily steroids, indicate that the cost of input and generation of such an index came to $0.25 per entry. M.W.R.

N68-24098# Stanford Research Inst., Menlo Park, Calif.
LOW-COST STORAGE AND RETRIEVAL OF ORGANIC STRUCTURES BY PERMUTED LINE NOTATIONS: SMALL COLLECTIONS
J. K. Horner *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 25–33 refs (See N68-24094 13-34)

A low-cost information storage and retrieval system for a small collection of organic chemical structures was generated based on Wiswesser coding that generates a permuted line-notation index. Of the first 2808 entries, only 54 encoding errors were found; and for 5000 compounds, only 10 compounds were found to be troublesome enough to require outside assistance in coding. Structure gathering and codification are discussed, automatic data processing and the computer program for using the file are noted, and time-cost data are included. M.W.R.

N68-24097# Diamond Alkali Co., Painesville, Ohio.
USE OF THE WISWESSER LINE NOTATION FOR REGISTERING COMPOUNDS
Charles E. Granito *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 35–37 (See N68-24094 13-34)

The Wiswesser chemical line notation technique is considered to be both a unique and unambiguous method of depicting chemical structures and to permit processing by unmodified automatic data processing equipment. The files are concise; and the average length for 90,000 structures was found to be 16.5 symbols. Economy of registering compounds by such a system is stressed. M.W.R.

N68-24098# Hoffmann–La Roche, Inc., Nutley, N. J.
FILE MAINTENANCE AND UPDATING PROCEDURE
Peter F. Sorter *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 39–42 (See N68-24094 13-34)

Wiswesser permuted notations have been found adequate for handling a file of about 70,000 chemical entries, which represent all of the compounds synthesized by an industrial complex. Procedures for entering a new compound into the file are noted, as are the means for updating and error correction and for overall file maintenance. Costs of such an information storage and retrieval system are mentioned, including the small outlay in computer time required for its implementation. M.W.R.

N68-24099# Diamond Alkali Co., Painesville, Ohio.
QUICK SCAN AND SYMBOLS
Alan Gelberg *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 43–48 (See N68-24094 13-34)

A reference list of the line-formula notation symbols used in the Wiswesser system for classifying chemical compounds is presented, and a general discussion of the Wiswesser technique is included. Note is made of the means by which the common elements of C, N, and O are represented; and that the various notations for a specific element represent the manner in which bonding to another atom takes place. It is concluded that the symbols in the Wiswesser notation can be used to generate listings that can be scanned visually or by computer methods, to serve as the basis for a computer method for determining molecular formulas and molecular weights, to generate tables of symbols in an inverted order to be used as fragment tables, and to generate a connectivity table to obtain packed storage. M.W.R.

N68-24100# Dow Chemical Co., Denver, Colo.
AUTOMATIC GENERATION OF STRUCTURAL FRAGMENT CODES FROM THE WISWESSER LINE NOTATION FOR RAPID STRUCTURE SEARCHES
Carlos M. Bowman, Franc A. Landee, Mary H. Reslock, and Betsy P. Smith *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 49–56 refs (See N68-24094 13-34)

A computer program is described that can create fragments from the Wiswesser permuted notations, suffixes, and molecular formulas; and produce a comprehensive numerical fragment code. The fragments are organized into an inverted file index to permit the application of concept coordination techniques at search time. This system, which can handle large volumes of information rapidly and economically, is used as part of an integrated industrial chemical information system that handles many other types of information. The fragmenting process or coding in Wiswesser representation of structure, code definitions, and means of searching the inverted files formed from such fragments or codes are described. M.W.R.

N68-24101# Canadian Industries Ltd., New Toronto (Ontario).
COMPUTER GENERATED OPEN ENDED FRAGMENT CODE
Ernest Hyde *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 57–67 (See N68-24094 13-34)

A computer program that uses Wiswesser symbols permits the generation of fragments that are largely unknown and the entry of new chemical compounds to a file. The program operates from either the notation-using portions of the matrix programs or directly from the compacted matrix. Each generated fragment, containing two to six Wiswesser symbols in canonical form, is assigned a number; and a compound is registered by entering its serial number under each fragment contained in the molecule in an inverted magnetic tape file. A KWIC program lists the fragments and brings together all fragments containing the same Wiswesser symbols; and, therefore, leads the information searcher to subfragments contained in larger fragments. Some compounds and their fragments in Wiswesser symbols are listed; and an example of the open-ended fragment code derived from the Wiswesser connectivity code is included. M.W.R.

N68-24102# Lilly (Eli) and Co., Indianapolis, Ind.
SUBSTRUCTURE SEARCHING ON NOTATIONS
George F. Fraction *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 69–79 refs (See N68-24094 13-34)

Manual and machine search modes that can be used to find the notations of chemical substructures are discussed, and effective query formulation is stressed as the means for effective searching. Manual searches are based on machine-prepared media and are directories prepared by KSOC (key symbol out of context) and the permuted chemical line notation computer programs. The QUEEK and SUBMAP computer programs for machine searches of manually-prepared questions are discussed. SUBMAP is an atom-by-atom, bond-by-bond substructure mapping program where both the reference structure and question structure are in the form of connection tables. QUEEK will execute searches for questions within a given system of symbols, such as chemical compounds that can be completely specified by sets of symbol strings. QUEEK can be used as a screening device to provide candidates for more exhaustive searches; and, while it does not have everything required of a total search system, QUEEK partially bridges the gap between manual searches on computer prepared directories and substructure searching. M.W.R.

N68-24103# Diamond Alkali Co., Painesville, Ohio.
PERMUTATIONS AND CLASSIFICATION NUMBERS
Alan Gelberg *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 81–84 (See N68-24094 13-34)

The Wiswesser line notation is considered to lend itself well to assisting in the classification of organic structures, which can be ordered in listings as to aliphatics, benzenoids, and multicyclics according to elemental compositions and as double bond counts. A list of permutations of chemical line notations alphabetized on individual symbols has been used to locate all compounds containing

any specific functional group as well as specific compounds and specific classes of carbocyclic and heterocyclic structures. A typical page from the 3rd edition of the Pesticide Index is used to illustrate the utility of a permuted index. It is noted that an industrial file of more than 100,000 compounds has been permuted into an index containing over 600,000 entries and another file with between 50,000 and 100,000 compounds is also working effectively. M.W.R.

N68-24104# Baker (J. T.) Chemical Co., North Phillipsburg, N. J.
SOME TECHNIQUES FOR THE MACHINE MANAGEMENT OF SMALL CHEMICAL DATA SYSTEMS
A. J. Barnard, Jr., W. C. Broad, C. T. Kleppinger, and W. J. Wiswesser (Ft. Detrick) *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 85–101 refs (See N68-24094 13-34)

Continuing studies in the machine management of a user-oriented chemical data system are described, along with collaborative efforts with an Army chemical installation. The hard-core elements of the chemical data system are listed, and the Wiswesser line notation system is described. Attention is also given to structure card layout, empirical formula field and symbols, computer-oriented chemical names, and classification numbers and codes. The BATCH number, which represents a structural-atomic classification code applicable to the management of a general collection of organic compounds, is described; as is the *ABET number for inorganic compound classification. The BATCH directory concept for small chemical data systems is mentioned. M.W.R.

N68-24107# Pennsylvania Univ., Philadelphia.
UTILIZATION OF THE WISWESSER NOTATION IN CIDS
Clarence T. van Meter *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 121–137 (See N68-24094 13-34)

Project CIDS, the Army's Chemical Information and Data System is concerned with the utility of the notation as a source of information on structural features for retrieval purposes; and views of CIDS and other programs on the utility of the notations are expressed. From the viewpoint of CIDS, a four-phase program to experimentally evaluate the use of notations is suggested that consists of constructing a suitable file of test queries, preparing a suitable file of test compounds, Wisswesserization of the test compounds and running the queries against the notated compounds, and assessing results from chemical accuracy, time, and cost standpoints. Typical CIDS queries are presented that detail the manner in which such a retrieval system might function to retrieve chemical compounds. M.W.R.

N68-24108# Lilley (Eli) and Co., Indianapolis, Ind.
CONNECTION TABLES FROM WISWESSER LINE NOTATION: A PARTIAL ALGORITHM
George F. Fraction, Justin C. Walker (NBS), and Stephen J. Tauber (NBS) *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 1 139–196 refs (See N68-24094 13-34)

An algorithm has been developed for transforming certain types of Wiswesser organic structure notations into connection tables. Acylic and benzene structures are treated, and provision has been made for all of the types of contractions used by the Wiswesser notation system. A separate algorithm is presented for treating linearly fused ring aggregates. A syntax has been developed to describe those portions of Wiswesser notations that refer to nonbenzene ring systems. Author

N68-24109# Pennsylvania Univ., Philadelphia. Dept. of Linguistics.
THE FORMAL ANALYSIS OF NOTATION SYSTEMS
James Munz *In* Army Edgewood Arsenal Wiswesser Line Notation Meeting Jan. 1968 p 197–202 refs (See N68-24094 13-34)

Linear notations as languagelike structures are viewed as exhibiting syntactic and semantic properties characterizable with the techniques of formal linguistics and mathematical logic. While there is no direct connection between the formal approach taken and the pragmatic approach that is evident among users, the two are strongly interconnected. It is only because there are regular semantic relations between the expressions of linear chemical notations and chemical structures that the notations are practical tools for storing and processing chemical information. The utility of linear notations as a mode of storing and processing large amounts of structural information depends on the existence of easily characterizable syntactic regularities reflecting semantic features in the codes. On the other hand, the practical demands of the chemist, who is the ultimate user and hence arbiter of notations even though his fluency in notations may not extend beyond a rudimentary knowledge of conventional nomenclature, forces notations to tolerate a reasonable amount of complexity in order to be able to provide chemically relevant structural information more easily and quickly. Author

N68-24166# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1969
GPO 1968 99 p Hearings before Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess., 20–21 May 1968
(Rept.-1136)

Reported is an appropriations hearing of the Committee on Aeronautical and Space Sciences that gives a summary on the congressional adjustments to NASA fiscal year 1969 budget. Requested are cuts in the research and development funds, in funding for the construction of facilities, and in the administrative operations requests. G.G.

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